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ANÆMIA in INFANCY: ITS PREVALENCE AND PREVENTION.

By

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Late British Medical Association Research Scholar.

The remarkable prevalence and the ill-effects of anæmia among London infants have been demonstrated by the following investigation, which also indicates a simple and efficacious method of prophylaxis.

Fairly large groups of artificially fed infant out-patients were observed for varying periods extending from October, 1925 to December, 1927. These infants were usually subnormal in health, but were not suffering from acute illnesses, and, after the first few weeks of attendance, compared not unfavourably with those at many London welfare centres. They were divided into the following groups:—(1) artificially fed infants without special treatment; (2) breast-fed infants; (3) those given light therapy; and (4) those given iron. Records were kept of the clinical history of each infant and of the hæmoglobin level of the blood.

Professor Major Greenwood, F.R.S., and Miss E. M. Newbold, M.Sc., kindly examined statistically many of the results, and the author is greatly indebted to them for this help. The results given in the appendix have been worked out or checked by them at the National Institute for Medical Research.

The Normal Percentage of Hæmoglobin in Infancy.

A digression is here necessary to indicate a preliminary difficulty in determining the incidence of anæmia in infancy, namely the lack of any fixed standard of comparison. Authorities differ widely as to the normal hæmoglobin percentage in the blood of infants.

Aschenheim, for example, has placed the lower limit of normal as low as 55 per cent., Finkelstein[1] at 65 per cent., and Holt[2] states that 75 per cent. is "about the average in healthy children." Hutchison[3] says that the hæmoglobin falls from 100 per cent. at 2 weeks to its minimum value of 70 per cent. at 6 months, thereafter remaining stationary until 2 years of age. C. S. Williamson's figures[4] have been widely quoted. In 1916 he determined by the spectrophotometric method the average grams of hæmoglobin per 100 c.cm. of blood for groups of healthy infants. Each of his figures is the average for 30 to 34 cases, and, exclusive of the first two weeks of life, they are as follows:—½ to 2 months 18·42 grm. (say 133 per cent. by Haldane's clinical standard); 3 to 5 months, 13·66 grm. (say 99 per cent.); 6 to 11 months 13·70 grm. (say 99 per cent.); 12 months, 12·53 grm. (say 91 per cent.); and 2 years, 12·57 grm. (say 91 per cent.). The figures in brackets are calculated by taking the Haldane hæmoglobinometer 100 per cent. standard as representing an oxygen-combining power of 18·5 per cent. or 13·8 grm. of hæmoglobin per cent. Williamson's figure for adults aged 21 to 25 years is 16·02 grm., say 116 per cent. by the clinical standard. Haden[5], using Van Slyke's blood-gas apparatus, found that for blood containing five million red cells per cm. the oxygen combining

power was 20·9 c.cm., which is equivalent to 15·6 grm. of hæmoglobin per 100 c.cm. His cases were adults. On the other hand, Stitt[6] states that in the adult the normal is usually given as 13 to 14 grm., per 100 c.cm. (say 94 per cent. to 101 per cent.), and that from 5 to 6 months until 12 to 15 years the normal is 11 grm. per 100 c.cm. (say 80 per cent.).

These statements sufficiently indicate the uncertainties of the subject. No figures appear available showing the level at each month of age in infancy, although it is hoped that the present investigation may in some measure have remedied this deficiency.

Clinical Material Investigated.

The total number of infants furnishing the material of this paper is 541, and the number of hæmoglobin estimations is 2,561. The most important group is that studied from 1925 to 1927 at the Queen's Hospital for Children and at a neighbouring clinic in Bethnal Green to which infant welfare medical officers sent children for consultation or light treatment. These numbered 434, of whom 333 were out-patients at the hospital and 101 at the clinic. Excluding 89 cases who had only one hæmoglobin estimation each, the average number of estimations per child was 6·2, performed at monthly intervals. The remaining 107 infants are included for comparison and fall into the following groups :— 53 unselected infants attending the Infant Welfare Department of the General Lying-In Hospital, Lambeth, in 1926 ; 21 out-patients at the Infants' Hospital, Westminster, examined in 1923 ; and 33 infants observed in a Vienna institution in 1921 and 1922. All statements, however, must be taken as referring to the 434 infants first mentioned unless the others are specifically included.

Economic status of the families. Both the Queen's Hospital for Children and the Bethnal Green clinic are situated in a poor and overcrowded district in the East end of London. Of 111 unselected, consecutive cases attending the Out-Patient Department of the Hospital in June, 1927, only 34 per cent. of the parents had a family income of over £3 per week, and 23 per cent. were receiving relief from the Guardians, or free milk from the borough, or both. At the General Lying-In Hospital the economic status was rather better. Of the infants examined in 1926, the parents of 18 per cent. were receiving relief or free milk, and this, in spite of possible differences in the scale of relief, probably represents a definite superiority in the average financial status of these mothers.

Age. The age of infants when first included varied from 3 weeks to 18 months, and none were over two years old at the end of their period of observation.

Physical condition. This was generally subnormal when first seen. The great majority were under normal weight, as judged for instance, by Griffith's standard weight curve[7] for healthy breast-fed infants. The artificially fed infants examined at the Queen's Hospital and the neighbouring clinic in 1925 to 1926 averaged 80 per cent. of normal weight at the beginning, and 87 per cent. at the end, of their period of observation (Table F.). After the first few attendances, the infants were of the type usually found at welfare centres. No children with acute illnesses were included, but those who subsequently developed such illnesses were not necessarily excluded, but were, so far as possible, followed up. The majority of infants were brought up on account

of errors in feeding, either quantitative or qualitative; others attended with constipation, bronchitis, sore throat or other minor maladies, and a few were convalescent from some more severe illness.

Attendance. In some of the tables given later a certain number of infants who attended only once are included, but with the great majority the periods of attendance varied from 1 to 12 months, and some longer. Attendance was, on the whole, fairly regular, although its frequency varied greatly. Thus during a period of food adjustment an infant might be seen twice or three times in the week, but when progressing satisfactorily the mother was asked to come at weekly, fortnightly or monthly intervals. At each visit, the child was weighed and was seen by the author, full notes being kept of its condition and progress. Infants ordered light treatment were expected to attend three days weekly in the Light Department[8]. General advice on hygiene and management was the same for all groups and was given by the writer.

Diet. In an investigation on anæmia the character of the diet is of importance. Two main dietetic groups were studied.

(1). *Artificially fed infants.* For these children the diet was wholly or chiefly artificial from the early months, though some cases received partial breast feeding until well on in infancy. To infants under eight months of age a fairly high percentage of the total caloric needs was given in milk with the idea of minimizing the risk of unsuspected deficiencies in any of the less well understood food constituents. Full cream dried milk (a roller-process milk), was used and cane sugar added. Usually between 70 and 85 per cent. of the total calories were supplied as dried milk, though this might occasionally sink to 60 per cent. for short periods. Thus the amount of milk given before mixed feeding was begun varied with the age and size of the child up to a maximum of about 2-lbs. of dried milk in the week, say, the equivalent of about $1\frac{3}{4}$ pints of fluid milk daily. Generally speaking, an infant of about 10 lb. consumed at least 1 lb. of dried milk weekly, the equivalent of nearly 1 pint of fluid milk daily. The amount of sugar varied from 6 to 9 drachms (90 to 135 calories), in the 24 hours. Young infants received a higher percentage of sugar than older ones.

All infants were ordered one or more teaspoonsful of orange or tomato juice daily, as well as cod-liver oil throughout the winter months.

It is well recognised that prolonged exclusive milk feeding may cause anæmia. In this investigation, however, mixed feeding was begun younger than is frequently advised. Between 8 and 9 months of age the daily consumption of milk was reduced to about 1 to $1\frac{1}{4}$ pints, and other foodstuffs were added to the diet, including eggs, three or more weekly, gravy, soup, fish, vegetables and a daily ration of fruit. At 12 months meat on three to six days in the week was ordered. On the whole, advice regarding diet appeared to be fairly satisfactorily carried out; that is, the kind of food advised was given.

(2) *Breast-fed infants.* The other main dietetic group consisted of children entirely breast-fed until 7 months of age or later. Many of these were given cod-liver oil and orange juice. The feeding advised from 8 months onwards was the same as for artificially fed infants.

The infants at the General Lying-In Hospital were fed on similar lines, but the diet of those at the Infants' Hospital and in Vienna was different and will be considered later.

Hæmoglobin Estimations.

The total number of hæmoglobin estimations on which this paper is based is 2,561, all done by Haldane's[9] method. Haldane's standard tube is so calibrated that 100 per cent. represents an oxygen-combining power of 18·5 c.cm. or 13 grm. of hæmoglobin per 100 c.cm. All the estimations at the Queen's Hospital for Children and the Bethnal Green clinic were made by one observer, Miss Lorel Goodfellow, and numbered 2,228. The blood was taken in the forenoon from a prick in the heel, precautions being taken first to warm the foot. Whenever possible, the estimations were repeated for each child at monthly intervals. When the colour of the tubes was being matched, the previous reading was, as a rule, unknown. The estimations at the General Lying-In Hospital were also made by Miss Goodfellow, and those at the Infants' Hospital and in Vienna by the author using the same method. From observations made in Vienna, the author is of opinion that even when precautions are taken to warm the part, the average hæmoglobin estimation obtained by pricking an infant's heel is distinctly lower than that obtained by pricking the ear. This is presumably due to a difference in the capillary circulation, but as all estimations in this series were made from the heel, this factor need not be considered further.

The Effect of the Mercury Vapour Quartz Lamp on the Hæmoglobin Level of Artificially Fed Infants.

The first comparison was made between a control group of artificially fed infants and a similar group treated with the mercury vapour quartz lamp, the form of lamp most commonly used in this country for the treatment of infants. These two groups were followed up for thirteen months, from October 1925 to October 1926 inclusive. The general progress and the average hæmoglobin percentage of the blood of the two groups were compared, but in this paper only the latter will be considered as it has already been shown[8] that there was little difference in rate of weight increase or in the number of intercurrent illnesses in the two groups, and that such differences as there were, were not all in favour of either the one or other group. Full details of treatment are given in the previous paper.

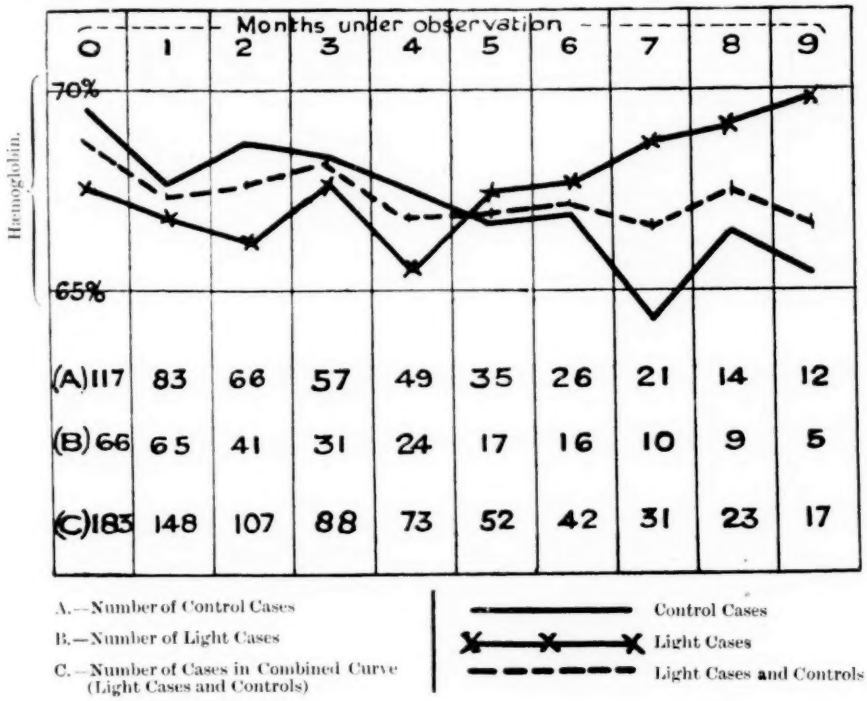
The control cases whose blood was examined numbered 218, and the cases given light treatment 66. Only those receiving a minimum of five light treatments per 4 weeks have been included. A few cases are included first in one group and then in the other. In each month a certain number ceased to attend and others were included, so that comparatively few cases could be followed up for the whole thirteen months.

The variations in the hæmoglobin level can most easily be studied in charts whenever the number of observations is sufficient to give a satisfactory average. Under each chart will be found figures indicating the number of observations upon which each average is based. For the present we are concerned with a comparison between light cases and their controls, and the significance of the curves obtained will be discussed later.

Cases classified according to time under treatment. Chart I illustrates the effect of duration of treatment, both in the control cases and in those given light treatment, and shows no appreciable difference between the two. They started within 2 per cent. of one another and after six months' observation were still within 2 per cent. of each other. After six months the number of cases remaining under observation is not sufficient for a fair comparison. Since, however, a greater contrast might be obtained by comparing the two groups in winter (November to May), when the exposure to sunlight was at a minimum, this was done and the results plotted on Chart II. The two curves follow each other remarkably closely. Some cases ceased to attend each month and the total numbers are comparatively small, so that an effort was made to

CHART I.

LIGHT TREATMENT: HÆMOGLOBIN LEVEL AT VARIOUS PERIODS UNDER OBSERVATION.



eliminate a possible source of error in comparison by averaging for each month the loss or gain in hæmoglobin instead of the whole numbers, as shown in Chart III. For the first three months the curves again run together and only diverge when the number of observations is small, again showing no appreciable difference between the light and non-light groups.

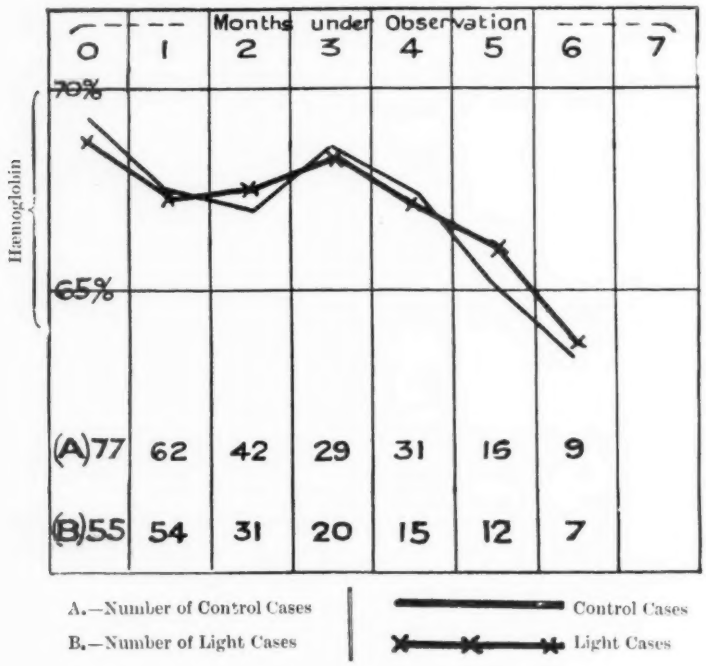
Cases classified by age. The same groups of cases are classified by age in Chart IV, showing that a similar curve exists in both groups, and that up to thirteen months of age the averages differ only very slightly. After this the numbers are too small to allow of any conclusions being drawn.

Cases classified by season. Neither curve (Chart V.) is smooth, but there is no evidence of the superiority of one group over the other.

Individual cases receiving light treatment. A study of individual case-sheets bore out the same conclusions and furnished no evidence that treatment with the mercury vapour quartz lamp, as here given, was either a prophylactic or a curative agent in anæmia. The average hæmoglobin percentage of the nine most anæmic cases of the light series was 50 per cent. at the beginning of observation. During light treatment (1 to 7 months), four dropped slightly and five rose slightly. The most anæmic were given other treatment after one or two months.

CHART II.

LIGHT TREATMENT: HÆMOGLOBIN LEVEL (WINTER) AT VARYING PERIODS UNDER OBSERVATION.



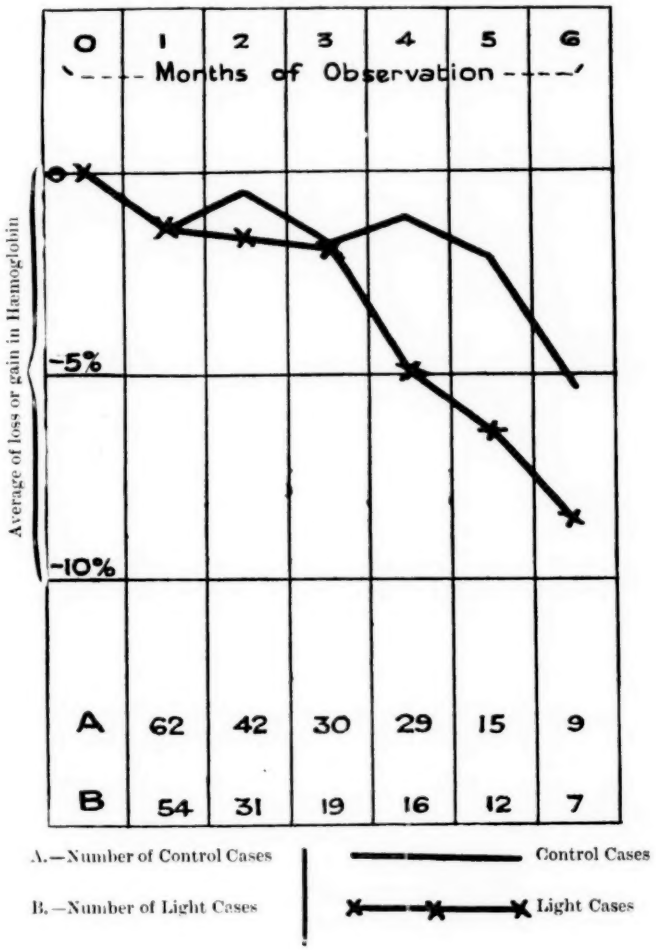
THE EFFECT OF THE CARBON-ARC LAMP ON THE HÆMOGLOBIN LEVEL OF ARTIFICIALLY FED INFANTS.

The cases treated with the long-flame carbon-arc lamp numbered only eleven and could, therefore, furnish no conclusive evidence of its effect. In individual cases, however, this treatment did not prevent a large drop in the hæmoglobin percentage, either in the first two months of life or after four to six months of age. In eight cases the final hæmoglobin estimation was lower than the first, and in three it was higher. Treatment was given two or three days weekly at a distance of about one yard, and the maximum exposure was half-an-hour. Barenberg and Lewis[10] working with in-patients (9 irradiated cases and 10 controls), considered there was an initial stimulant effect followed by a depressant effect. The present investigation provided no evidence of these two phases.

The Hæmoglobin Percentage in the Blood of Artificially Fed Infants: Light and Non-Light Cases Combined.

Since it has been shown[8] that there is no evidence that treatment with the mercury vapour quartz lamp altered in any way either the hæmoglobin level of the blood, or the weight curve, or diminished the liability to infection, it is legitimate to combine these two groups of artificially fed infants in order

Chart III.
Alterations in Hæmoglobin Level in Winter at Varying Periods under Observation.



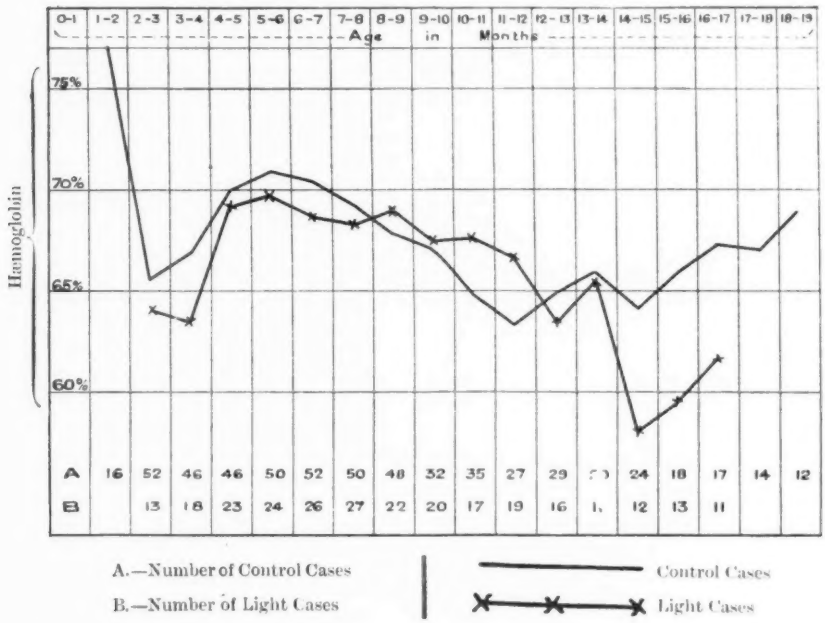
to obtain a larger control series for purposes of comparison. Charts I, V and VI show the hæmoglobin curves obtained by combining the light and non-light cases of 1925-26.

Effect of duration of attendance. The great majority of infants improved in general health while under observation, as would be expected. This was evident from their appearance and was supported by the fact that whereas at the beginning of observation they averaged about 80 per cent. of normal weight,

at the end they attained an average of about 87 per cent., Griffith's curve[2] for healthy breast-fed infants being taken as the standard. This improvement in general health was, no doubt, due to many factors such as : better adjustment of diet, better general hygiene and management (*e.g.*, more out-door life), and the clearing up of any temporary ailment, such as an attack of bronchitis. An associated improvement in the percentage of hæmoglobin in the blood might have been expected, but on the whole this failed to appear. Chart I shows a slight drop in hæmoglobin during the time under observation. Of course in individual cases such an increase did occur, but it was more than balanced by the fall in others.

Effect of age. This is of special interest, and, so far as the author is aware, a curve showing the hæmoglobin level at each month for the first year of life

CHART IV.
HÆMOGLOBIN LEVEL AT DIFFERENT AGES.



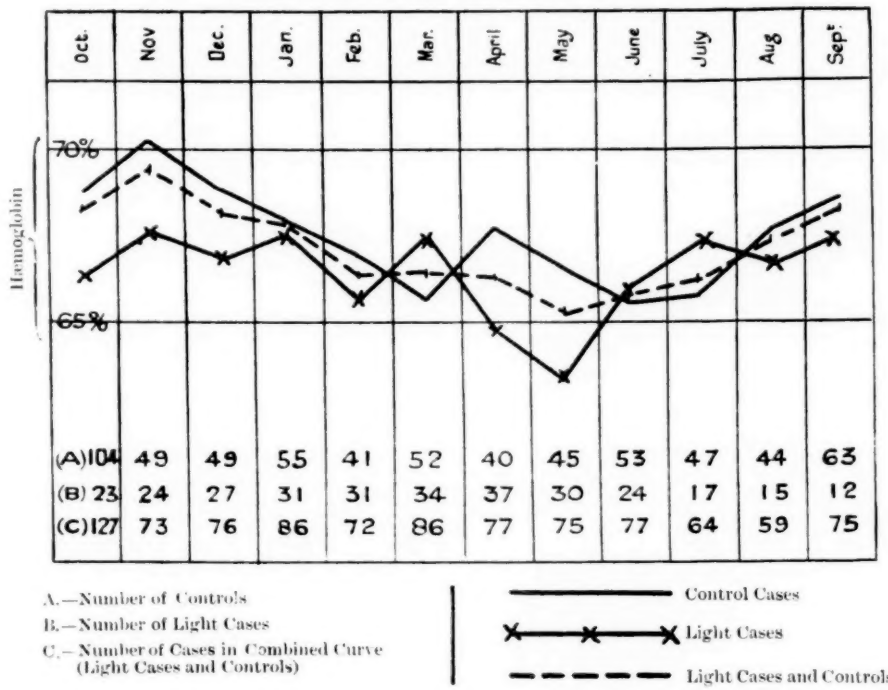
has not previously been published (see Chart VI). A figure for the new-born was not obtained, but it is well known that this is high, over 110 per cent at least. The drop of the first few weeks of life continues sharply down to about 65 per cent. at two months of age, thereafter there is a rise to about 70 per cent. at five months, followed by a steady fall until about twelve months of age when the average hæmoglobin percentage is under 65 per cent.

At every age infants dropped out of the series and fresh cases were included and it became desirable, therefore, to eliminate this possible source of error. Chart VII, which shows the average of the loss or gain of each child in hæmoglobin percentage at each month of age is, therefore, very probably a truer representation of the facts than Chart VI. The shape of the curve up to 12 months is the same ; from 12 to 18 months numbers are small, but the curve

shows the hæmoglobin level until 17 months remaining about the same as at 12 months. This type of curve with the double drop, the first from birth to two months and again after six months, is repeated so often that it cannot be the result of chance. Whether these figures reveal the presence of widespread anæmia depends on what the normal hæmoglobin level may be at each month of age and will be discussed later.

Effect of birth weight. The curves obtained by grouping the infants so far as possible according to their birth weight (Chart VIII) are suggestive though not conclusive, partly because of the uncertainty attaching to the mother's statement of birth-weight and also because the numbers are extremely small. The curves indicate, however, that *both* the initial fall in hæmoglobin and

CHART V.
HÆMOGLOBIN LEVEL AT DIFFERENT SEASONS.



the fall after the age of six months depend in part on the weight at birth. The smaller the infant at birth, the greater the fall. It is, of course, well known that premature babies nearly all become anæmic. It does not, however, appear to be known that they, as well as full-time children, show a double drop in hæmoglobin, with a rise till about five or six months old after the initial fall. The effect of birth weight is indicated in Table A.

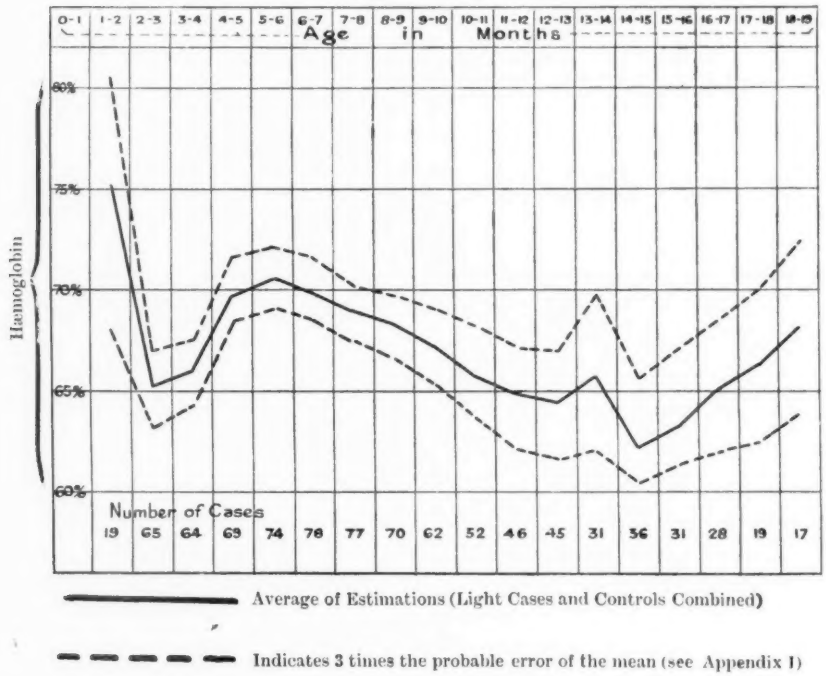
Effect of sex. There appeared to be little, if any, difference between the sexes in the hæmoglobin level, and separate curves are, therefore, not shown.

Effect of season. The season curves (Charts V and IX), suggest a slight drop in the hæmoglobin level from November to May and a slight rise in the summer months. Confirmatory evidence of a seasonal variation is, however, wanting,

TABLE A. EFFECT OF BIRTH WEIGHT ON HÆMOGLOBIN LEVEL.

Birth weight.	No. of cases.	% showing Hb. below 60%.
Under 5 lb.	14	86%
5 lb. odd	16	31%
6 lb. „	43	28%
7 lb. „	56	18%
8 lb. „	44	16%
9 lb. and over	27	15%
	Total 200	Average 25%

CHART VI.
AVERAGE HÆMOGLOBIN PERCENTAGE IN ARTIFICIALLY FED INFANTS AT DIFFERENT AGES.



as the same type of curve does not always repeat itself (see Chart V), and if the curves are corrected for age (see Charts X and XI and Appendix), they fail to prove any seasonal difference that does not fall within the limits of possible chance variation. The difference in Chart XI may perhaps reflect the lesser incidence of infections in summer. It would be interesting to have further data on the point.

THE HÆMOGLOBIN LEVEL IN BREAST-FED INFANTS.

To obtain regular hæmoglobin estimations on a series of apparently healthy breast-fed infants proved more difficult than to obtain similar figures for the artificially fed and the total numbers are consequently small ; 74 infants in all.

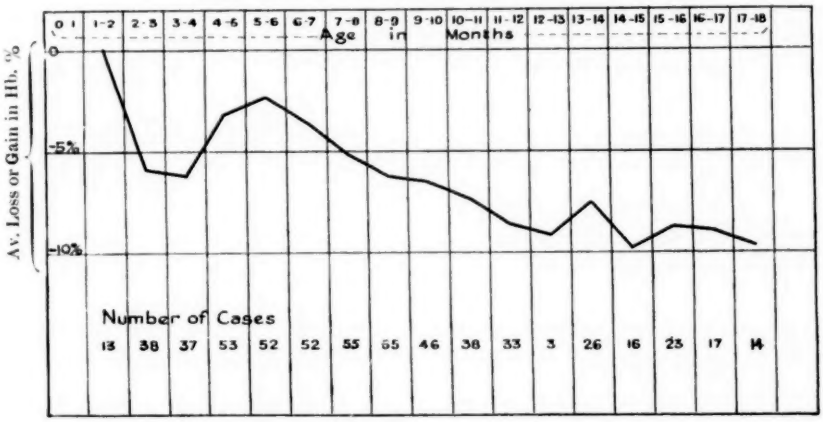
These when first seen were, for the most part, sub-normal; in fact, they were similar in type to the artificially fed infants. An infant was counted as breast-fed if it received nothing but breast milk until 7 months of age, supplements of fruit juice or cod-liver oil not being taken into consideration. Chart XII shows the average hæmoglobin level for each month of age. The type of curve, (irregular on account of the small numbers), is, on the whole, similar to that of the artificially fed infants, but is higher at every age. At what may be regarded as the critical points of the curve, i.e., at two months, five months and twelve months, it is more than 5 per cent. higher; nevertheless, after the first month of life it reaches 75 per cent. only between five and seven months of age.

Comparison of the Control Groups with Other Groups of Infants.

The infants so far considered were all out-patients either at the Queen's Hospital for Children or at a clinic for ailing children. The criticism may, therefore, be made that in spite of suggestions to the contrary, these do not give

Chart VII.

Average Loss or Gain in Hæmoglobin Percentage at Each Month of Age.
(Light Cases and Controls Combined.)



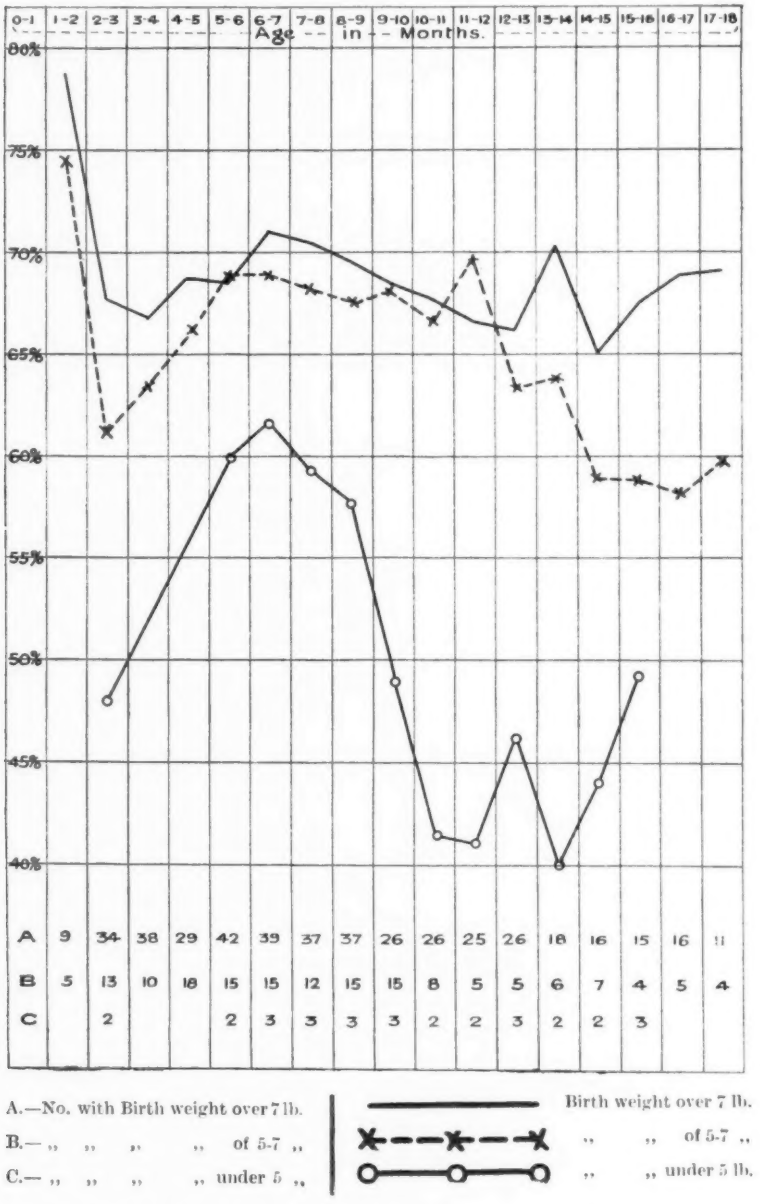
a true picture of the average hæmoglobin level in artificially fed infants. It will probably be admitted, however, that infants attending a good welfare centre are at least up to the average of infants of working-class mothers in the district.

53 children were, therefore, examined in the spring of 1926 at the Infant Welfare Centre of the General Lying-In Hospital, Lambeth. The level of health here was probably above the average for such institutions in London, because the numbers attending the centre are comparatively small, and the help and advice given to individual mothers considerable. Of the 53 infants tested, 32 were entirely breast-fed or had been so fed until 7 months of age, and 21 were partially or entirely artificially fed. A certain number were believed to have received iron for short or irregular periods. Among those over one month only one exceeded 75 per cent., and the average hæmoglobin percentage, excluding infants under one month, was 70 per cent. for 28 breast-fed, and 66 per cent. for 21 bottle-fed babies. These figures for unselected

welfare centre cases are, as it happens, actually slightly lower than the corresponding figures in the control series from the Queen's Hospital and the Bethnal Green clinic: these were approximately 73 per cent. for breast-fed, and 69 for artificially fed infants when first seen.

CHART VIII.

INFLUENCE OF BIRTH WEIGHT ON THE AVERAGE HÆMOGLOBIN PERCENTAGE.



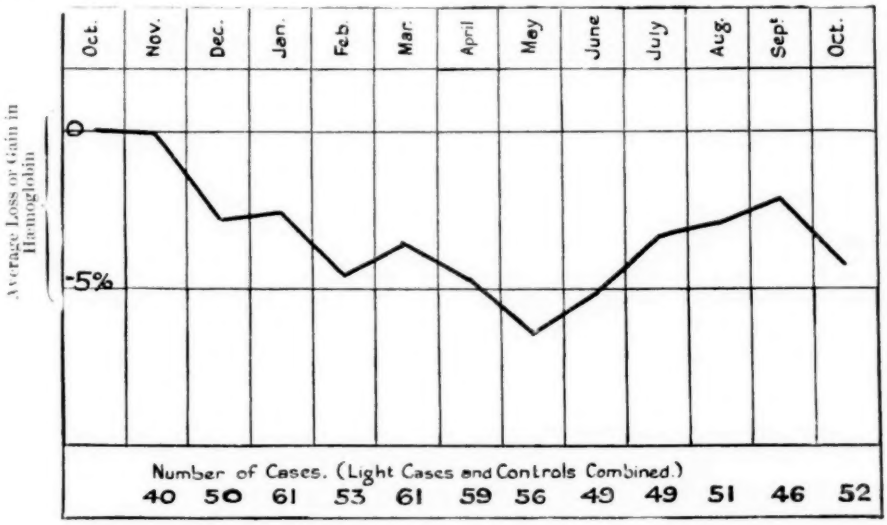
The method of feeding might also be held accountable for the hæmoglobin level found in the artificially fed group. Infants on other methods were, therefore, also examined. In 1923 the author estimated the hæmoglobin percentage in 21 infants, the majority of whom were entirely artificially fed,

at the Infants' Hospital. The type of case was similar to that followed up at the Queen's Hospital, but the methods of feeding differed and included "humanized feeds" and veal broth from early infancy. The children's ages varied from 3 to 18 months, and the average hæmoglobin level was again 69 per cent.

Another set of figures for comparison was taken from 33 infants, artificially fed from an early age, who were kept under observation in an institution in Vienna.[11] The average of the last hæmoglobin estimation on each infant before discharge, or before the administration of iron, was 62 per cent. The ages of the infants varied from 5 to 18 months. They were on two contrasted types of feeding: one group received until 9 months only dried milk with added fruit juice and cod-liver oil, and was protected from rickets; the other group received fresh cow's milk with heavy carbohydrate additions and fruit juice, and was not protected from rickets. The latter group was given vegetable

CHART IX.

AVERAGE LOSS OR GAIN IN HÆMOGLOBIN PERCENTAGE AT EACH MONTH OF THE YEAR.



purée daily from six or seven months of age onwards. There was no evidence that one group was superior to the other in hæmoglobin content of the blood. Only four of the infants were over twelve months old, and their hæmoglobin percentages lay between 39 per cent. and 58 per cent.

The estimations here and at the Infants' Hospital were made by the author and are, therefore, not strictly comparable with those in the main groups.

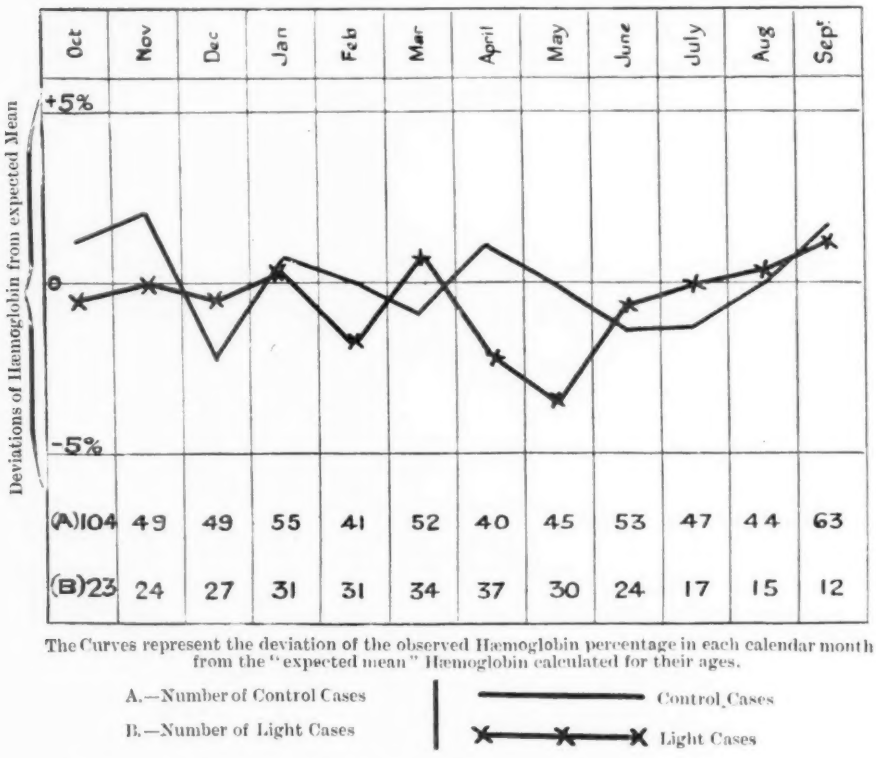
EFFECT OF IRON ON HÆMOGLOBIN LEVEL IN ARTIFICIALLY FED INFANTS.

So far the investigation showed that all the groups of artificially fed infants had during most of the months of infancy a hæmoglobin level averaging between 60 per cent. and 70 per cent. Many individuals, of course, were very much lower than this. The effect of iron medication was next tried. It was argued that if the normal hæmoglobin level ranged between 60 per cent. and 70 per cent., the administration of iron would presumably leave it unchanged; if, also, these

values indicated anæmia, but the anæmia was due to some dietetic defect other than iron deficiency, or to repeated minor attacks by micro-organisms, then again no great effect was to be expected from iron treatment.

Iron salt used. The salt used was iron and ammonium citrate. This was chosen on account of its ready solubility and easy toleration. A sample was kindly examined by Dr. S. S. Zilva, who found it to be a pure salt and to contain 20·8 per cent. of iron. Recent experimental work indicates that the iron preparations in common use differ greatly in therapeutic value, and the choice of a salt is, therefore, of considerable importance. Mitchell [12, 13] *et al.* have shown, since this work was begun, that iron and ammonium citrate is a particularly effective salt in experimental anæmia in rats.

CHART X.
SEASONAL HÆMOGLOBIN CURVES CORRECTED FOR AGE.



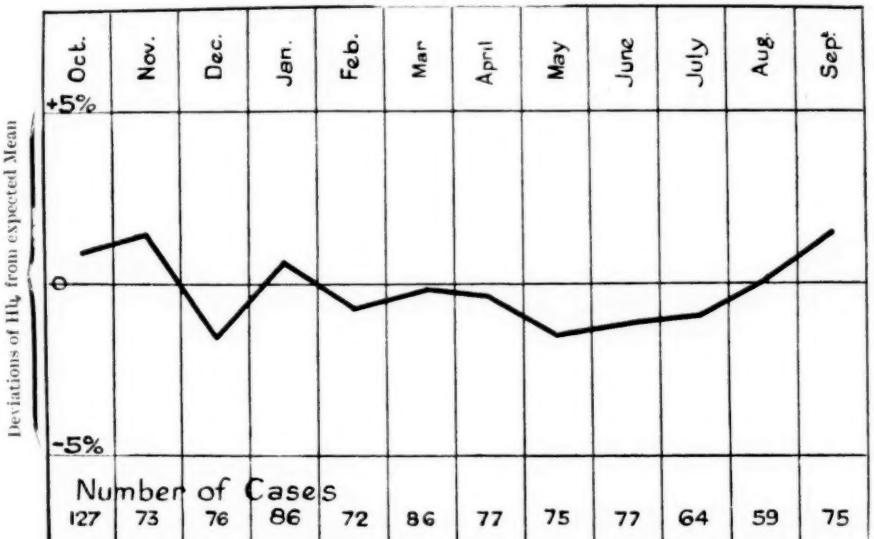
The Curves represent the deviation of the observed Hæmoglobin percentage in each calendar month from the "expected mean" Hæmoglobin calculated for their ages.

A.—Number of Control Cases
B.—Number of Light Cases
Control Cases
Light Cases

Dosage and method of administration. Except for very young infants, or those with some digestive trouble, the dose given varied between 4½ and 9 grains daily, though this was occasionally exceeded. The iron was at first ordered as a mixture, sweetened with syrup, given in three doses daily, generally in the milk. So much uncertainty attached to this method of administration among out-patients that another and more satisfactory method was tried. From January to December, 1927, the West Surrey Central Dairy Co. (vendors of " Cow & Gate " milk), kindly arranged through their chemist, Mr. J. Tavroges, B.Sc., to supply the writer with dried milk containing added iron and ammonium citrate, thus greatly facilitating the regular administration of

iron. This salt was added in solution before the milk was dried on the rollers. The amount added was 31½ grains to each pound of dried milk, so that if one pound was consumed in one week, the intake of iron and ammonium citrate per day was 4½ grains. This milk was supplied to mothers from the Queen's Hospital. In many cases, for those infants taking under 1½-lb. of dried milk per week, an additional 2¼ grains of the iron salt daily was ordered in the form of a mixture, but the total dosage per day still varied between 4½ and 9 grains or a little more. At the Bethnal Green clinic the iron mixture alone was used as the medicated dried milk was not available. For very young infants, or those recovering from digestive disturbances, the precaution was taken of beginning the salt gradually. The iron was excellently tolerated. Very occasionally it appeared to cause looseness of the stools if the whole dose was given at the outset.

CHART XI.
SEASONAL HÆMOGLOBIN CURVE CORRECTED FOR AGE—COMBINED LIGHT CASES AND CONTROLS.



It was found wise to warn mothers that the stools would be dark, and there were occasional complaints that it increased the odour of the stools. Older infants occasionally tired of the dried milk.

A record was kept of each packet of medicated "Cow & Gate" milk sold or given to a mother, and as there was little likelihood of the food being thrown down the sink, in contradistinction to the possible fate of medicine, it became possible to estimate accurately the amount of iron and ammonium citrate consumed by each infant. Many mothers fetched the child's weekly supply of dried milk with absolute regularity.

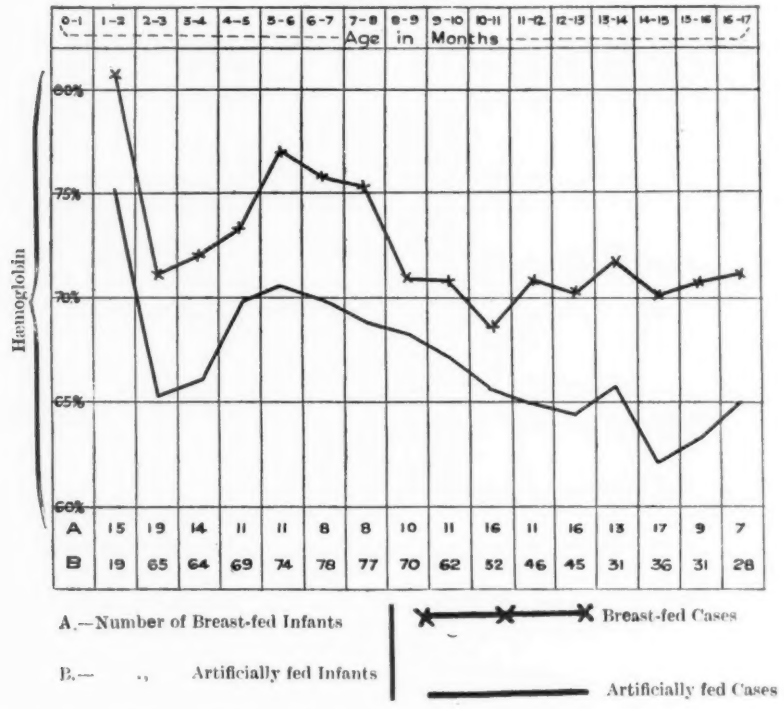
A. Cases treated in 1925-26. During 1925-26 a large number of the children given iron were selected on account of anæmia, and had been previously included in the control or the light treatment group. The number of cases was 35, and the results of treatment are given in Chart XIII, showing the average hæmoglobin percentage after 1, 2, 3, etc., months of treatment. These

infants started with an average of 57·9 per cent., and rose steadily in the course of six months to nearly 80 per cent., an average increase of over 20 per cent., though in the previous four months they had shown an average drop of 6 per cent. This curve is constructed not from selected iron cases, but from every case having iron during this period and attending for hæmoglobin estimations. Of the 35 cases, only one showed no increase in hæmoglobin percentage, and that case had no iron for four out of the six weeks under observation.

B. Cases treated in 1926-27. These were artificially fed and of the same type as to the control series of 1925-26. They were not selected anæmic infants, and the average initial hæmoglobin percentage was almost identical with that of the controls. They numbered 132, of whom about 60 were infants who had been included in the control series before October, 1926.

CHART XII.

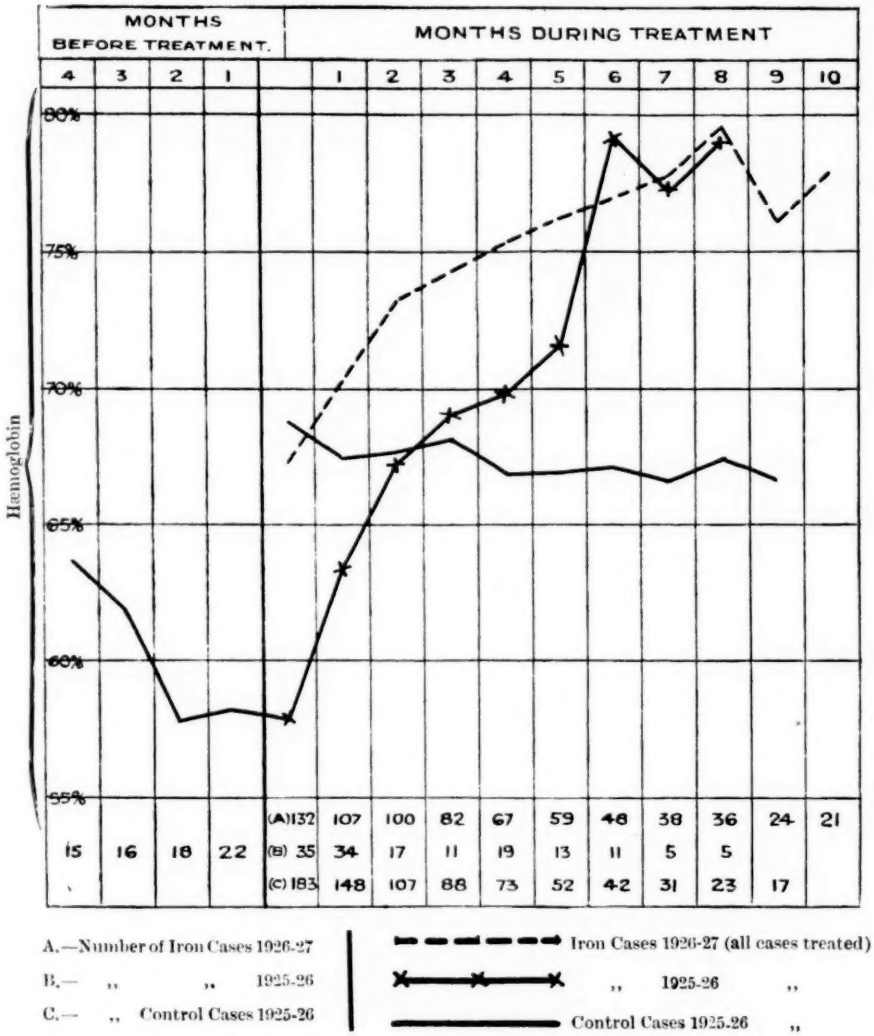
AVERAGE HÆMOGLOBIN PERCENTAGE OF BREAST AND ARTIFICIALLY FED INFANTS AT DIFFERENT AGES.



Cases classified according to time under treatment. Every child who had iron for any period and attended for hæmoglobin estimations is included (see Chart XIII). There is no doubt that many of them did not take their iron regularly, but on account of the difficulty of drawing any line between those who did and those who did not, all are included. The average hæmoglobin percentage in the blood at the outset is almost identical with that of the controls, the rise in the curve is less steep than in the case of the children starting at a lower level, but it is steady and reaches nearly 80 per cent., an average rise of 12 per cent. In individual cases getting regular treatment the rise might be dramatic; as, for example, over 30 per cent. in three weeks.

CHART XIII.

EFFECT OF IRON TREATMENT. CASES CLASSIFIED BY DURATION OF TREATMENT.



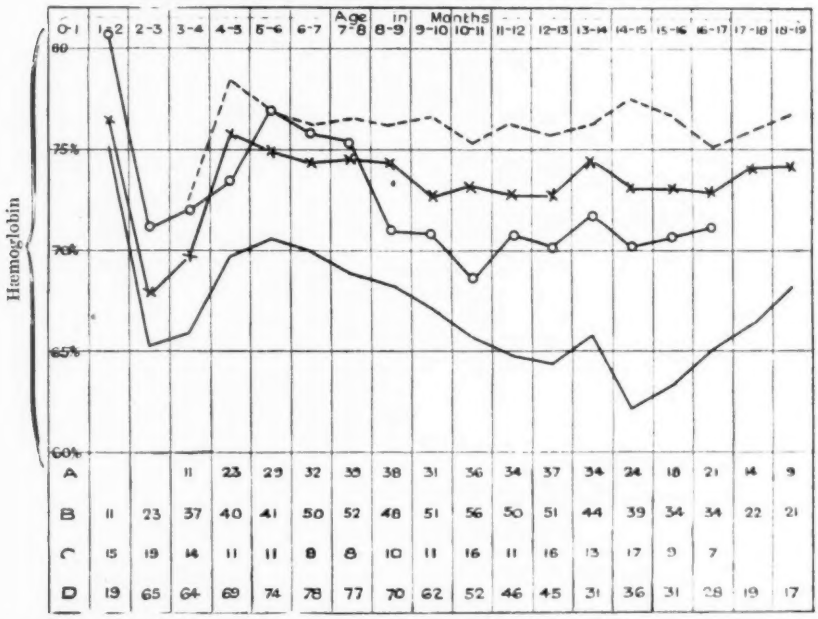
Cases classified according to age. Chart XIV shows the 1926-27 children grouped by age. Again, for reasons given above, every case given iron is counted. It must be remembered that at every month of age new cases were included so that this curve does not represent the hœmoglobin level produced by continuous iron treatment from an early age. It will be seen that in the cases examined iron administration did not prevent an initial drop by two months to 67·8 per cent., but the number receiving iron regularly during the whole of the month preceding this observation was very small. From two months onwards the iron cases are consistently higher than the artificially fed controls. At four months old, the iron cases average 6 per cent. higher in hæmoglobin, at twelve months 8 per cent., and at 18 months 6 per cent. If those estimations are excluded in which there was definite evidence of inadequate

dosage during the preceding month, the curve is 2 per cent. to 4 per cent. higher still, and remains above 75 per cent. from four months onwards. From five months old onwards it remains higher than that of the breast-fed controls.

Chart XV shows the effect obtained according to the age when iron was first administered. The numbers are small, but the facts seem clear. The later iron therapy is begun, the lower the hæmoglobin level tends to be throughout infancy. Those given iron before two months old have reached approximately 80 per cent. by four months old, and do not drop below this level. By ten months old the infants started between two and four months have reached 81 per cent. ; those started between four and seven months are at about 74 per cent. ; those started at seven to ten months are at about 70 per cent., and the controls are at 66 per cent.

CHART XIV.

EFFECT OF IRON TREATMENT. CASES CLASSIFIED BY AGE.



A.—Number of Iron Cases 1926-27 omitting those known to have had under 4½ grn. daily

B.—Number of Iron Cases 1926-27 (all cases)

C.— ,, ,, Breast-Fed Infants

D.— ,, ,, Control Cases—Artificially fed

Iron Cases 1926-27—omitting cases known to have had under 4½ grn. daily in previous month

Iron Cases 1926-27 (all cases)

Breast-fed Infants

Control Cases—Artificially fed

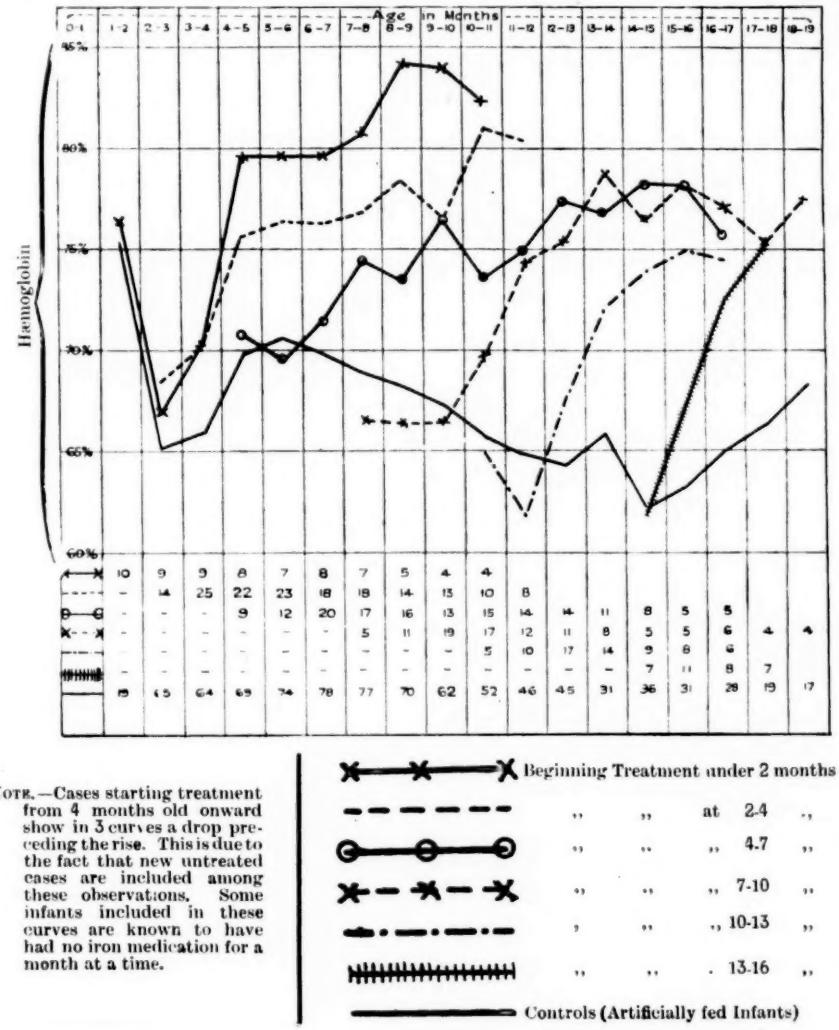
Number of infants whose hæmoglobin reached 80 *per cent.* The effect of iron administration on the hæmoglobin curve may be examined in another way, namely, by considering the number of infants in the different groups who reached 80 per cent. hæmoglobin after two months of age. Of the total control series only 7 per cent. reached this figure during the whole period of investigation. Of the corresponding iron-treated series 59 per cent. reached 80 per cent., although many were known to have had little iron, whereas of those who received an adequate amount of the medicated " Cow & Gate " milk 81 per cent. did so (Table B).

TABLE B. THE EFFECT OF ADMINISTRATION OF IRON ON HÆMOGLOBIN LEVEL.

Series.	No. of cases.	Reaching 80% hæmoglobin	
		No.	percentage
Series at Queen's Hosp. and Bethnal Green Clinic (including light treated cases), 1925–1926	273	19	7%
Total iron series (including every case), 1926–1927	132	78	59%
Cases receiving dried milk containing iron for not less than 1 month at the rate of 4½ grn. of iron and ammonium citrate daily	75	61	81%

CHART XV.

EFFECT OF IRON TREATMENT. CASES GROUPED BY AGE OF FIRST TREATMENT (1926-27).



NOTE.—Cases starting treatment from 4 months old onward show in 3 curves a drop preceding the rise. This is due to the fact that new untreated cases are included among these observations. Some infants included in these curves are known to have had no iron medication for a month at a time.

Beginning Treatment under 2 months old
,, ,, at 2-4 ,, ,,
,, ,, ,, 4-7 ,, ,,
,, ,, ,, 7-10 ,, ,,
,, ,, ,, 10-13 ,, ,,
,, ,, ,, 13-16 ,, ,,
Controls (Artificially fed Infants)

Percentage of children whose hæmoglobin was raised by iron. Of 132 infants, including every child given iron in 1926-27, the final hæmoglobin estimation was higher than the first in 81 per cent. (107 infants), and the same or lower in 19 per cent. (25 infants). Thirteen of the 25 can be accounted for as follows: four were infants under two months of age whose initial hæmoglobin level was 83 per cent. to 110 per cent.; eight were known to have had very little iron for the preceding month, and one was a case of acute mastoiditis.

The Effect of Iron on General Health.

The infants receiving iron were strikingly better in colour and looks than the control groups: not only that, but they looked healthier than any group of working-class infants the author has yet observed in London. Though the improvement in appearance was unmistakable, it is desirable to ascertain whether this was accompanied by any improvement in growth and in resistance to infection.

Resistance to infection. A comparison of the amount of intercurrent illness in two groups of outpatient infants attending at varying intervals must necessarily be subjective and open to fallacy: still, it is worth attempting. In order to secure sufficient numbers, infants observed in 1925-26 were used to control the iron-treated cases of 1926-27. This has the obvious disadvantage that an epidemic might completely mask the true conclusions as to the incidence of infection in the two groups. The mortality rate is not necessarily a true index of the morbidity rate, but with infants it seems legitimate to assume that any marked change in the morbidity rate for respiratory or gastro-intestinal disorders would be reflected in the mortality rate. A calculation based on the Registrar General's weekly returns shows that the average weekly deaths of infants in London from all causes (including deaths from diseases of the respiratory tract and from gastro-enteritis) did not differ markedly during the two winter periods under consideration, and it is assumed, therefore, that these periods are comparable. The two summer periods, however, differed in that the deaths from gastro-enteritis were twice as many in 1926 (the control period) as in 1927, and no deductions can, therefore, be made from the figures for the incidence of this disease in summer (Table C).

Table C. Average Weekly Mortality in London; Comparison of Period of Observation of Control Cases with Period of Observation of Iron Cases.
(Figures calculated from the Registrar-General's Reports.)

Period.	Deaths under 1 yr. from all causes.	Deaths under 2 yrs. from dis. of respiratory tract.	Deaths under 2 yrs. from diarrhœa and enteritis.
Winter—			
Period of observation of control cases	118	46	19
Period of observation of iron cases	111	49	15
Summer—			
Period of observation of control cases	77	14	20
Period of observation of iron cases	64	13	10

In compiling Tables D and E, the author counted as an illness any disturbance of health which caused a definite flattening of the weight curve or loss of weight, as well as all attacks of otorrhœa and all specific fevers which necessitated a suspension of attendance. No case in the iron series has been included which had previously been included in the control series, since it was known that these had improved in general health while under observation in the control group. The Tables show both winter and summer results, and give separate figures for the diseases of the respiratory tract, of the digestive tract,

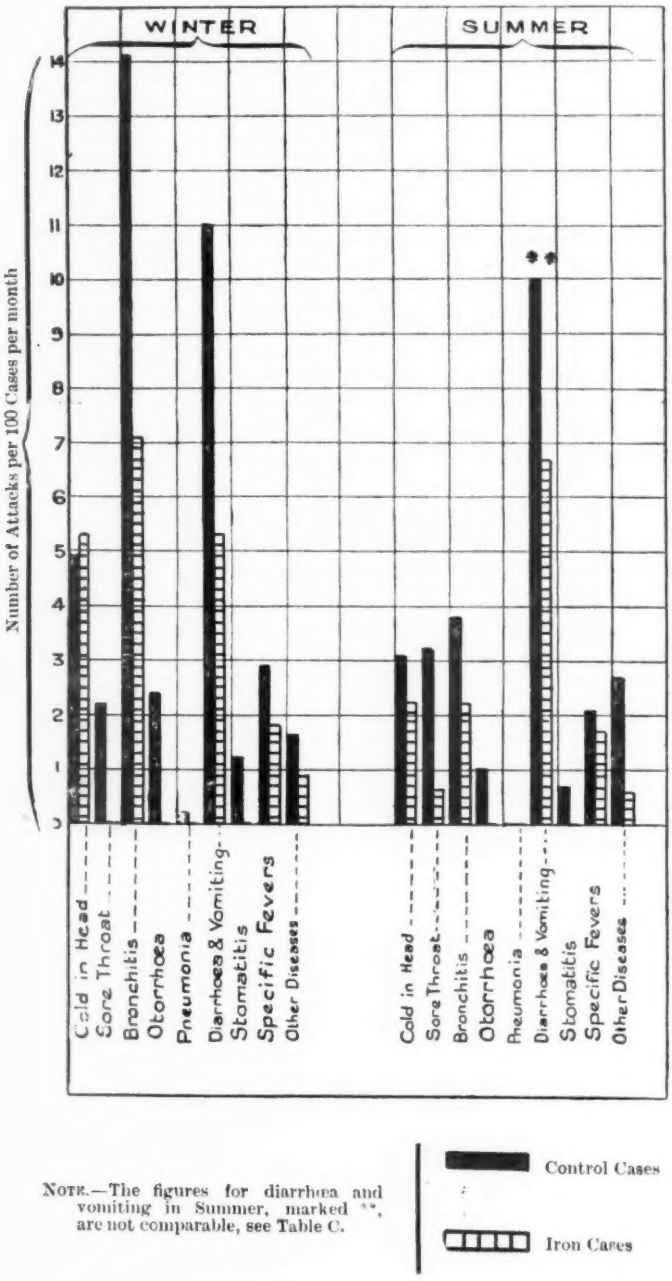
TABLE D. INTERCURRENT ILLNESSES.

	Winter. October–April.				Summer. May–September.			
	Control cases.		Iron cases.		Control cases.		Iron cases.	
No. of Infants ..	135		35		100		52	
Av. months of observation per infant	3·04		3·22		2·91		3·37	
Disease.	No. of attacks.	No. of attacks per 100 cases per month.	No. of attacks.	No. of attacks per 100 cases per month.	No. of attacks.	No. of attacks per 100 cases per month.	No. of attacks.	No. of attacks per 100 cases per month.
Respiratory tract :—								
Cold in head	20	4·9	6	5·3	9	3·1	4	2·2
Sore throat	9	2·2	0	—	10	3·4	1	0·6
Bronchitis	58	14·1 } 23·8	8	7·1 } 12·4	11	3·8 } 11·3	4	2·2 } 5·0
Otorrhœa	10	2·4	0	—	3	1·0	0	—
Pneumonia	1	0·2	0	—	0	—	0	—
Digestive tract :—								
Diarrhœa or vomiting ..	45	11·0	6	5·3	29	10·0	12	6·7
Stomatitis	5	1·2	0	—	2	0·7	0	—
Specific fevers	12	2·9	2	1·8	6	2·1	3	1·7
Other diseases	7	1·6	1	0·9	8	2·7	1	0·6
Total ..	167	40·5	23	20·4	78	26·8	25	14·0

and for total attacks of illness. The total morbidity rate of the iron cases both in winter and in summer is about 50 per cent. of that of the control cases (Table E)., and a reduced morbidity is present in each group of diseases. For respiratory diseases the comparison proves so strikingly in favour of the cases treated with iron (the incidence being approximately half), that the difference can scarcely be attributed to chance. The figures obtained for gastro-enteritis are less convincing on account of the differing mortality rates during the two periods, but the winter figures suggest that here too iron has diminished the incidence of the disease.

CHART XVI.

EFFECT OF IRON TREATMENT. THE INCIDENCE OF INTERCURRENT ILLNESSES.



NOTE.—The figures for diarrhœa and vomiting in Summer, marked **, are not comparable, see Table C.

TABLE E. NUMBER OF ATTACKS OF INTERCURRENT ILLNESS PER 100 CASES PER MONTH.

	Total attacks all diseases.		Attacks of diseases of the respiratory tract.		Attacks of diseases of the gastro-intestinal tract.		Attacks of specific fevers.	
	Per 100 cases per month.	Expressed as percentage of attacks in controls.	Per 100 cases per month.	Expressed as percentage of attacks in controls.	Per 100 cases per month.	Expressed as percentage of attacks in controls.	Per 100 cases per month.	Expressed as percentage of attacks in controls.
Winter :—								
Controls	40·5	—	23·8	—	12·2	—	2·9	—
Iron cases	20·4	50%	12·4	52%	5·3	43%	1·8	62%
Summer :—								
Controls	26·8	—	11·3	—	10·7	—	2·1	—
Iron cases	14·0	52%	5·0	44%	6·7	63%	1·7	81%

TABLE F. COMPARISON OF INCREASE IN WEIGHT OF IRON CASES AND CONTROLS.

	No. of cases.	No. of observations.	Average age at beginning of observation.	Average age at end of observation.	Average time under observation.	Average % deviation. at beginning of observation.	Average % deviation. at end of observation.	Difference between % deviation at end and beginning of observation
			Weeks.	Weeks.	Weeks.	A.	B.	B—A.
Boys.								
Control Cases	89	103	29·3	43·2	13·9	—18·07	—11·60	6·47
Iron Cases	30	32	28·8	49·5	20·7	—14·54	— 3·10	11·44
Girls.								
Control Cases	87	96	33·2	48·2	15·0	—21·51	—14·09	7·42
Iron Cases	31	34	25·0	47·6	22·6	—21·79	— 8·57	13·22
Boys and Girls.								
Control Cases	176	199	31·2	45·6	14·4	—19·73	—12·80	6·93
Iron Cases	62	66	26·8	48·5	21·7	—18·27	— 5·92	12·35

Control Cases. Babies up to 2 years old attending in 1925–1926.

Iron Cases. Babies up to 2 years old who attended in 1926–1927 and received iron for 4 weeks and upwards. Cases previously included in the control group have been excluded.

Normal Weight. Griffith's standard weight curve for healthy breast-fed infants has been taken as the normal.

Average percentage deviation from normal weight (columns A and B), is the average for each group of cases of $\frac{\text{(observed weight—normal weight) 100}}{\text{normal weight.}}$

Rate of Recovery. It was moreover, noticeable in the course of the work that the rate of recovery was considerably better in the iron group than in the control group, although this cannot be represented in the table.

Rate of Growth. To compare the rate of growth, the same groups of cases were used, i.e., the iron cases who had not previously been included in the control group were compared with the whole control group (see Appendix II). The average period of attendance was longer in the iron group, which makes a fair comparison difficult. Table F shows that both groups started 18 per cent—19 per cent. under normal weight, and that whereas controls improved by 6·9 per cent., iron cases improved by 12·4 per cent., i.e., they caught up on the normal by nearly double as much, though in a longer period.

Discussion.

The normal percentage of hæmoglobin in the blood in infancy.

It is reasonable to assume that giving iron by mouth will not raise the hæmoglobin level above the normal : consequently it may be concluded that the normal after three months of age is not less than 80 per cent. Concerning the earlier months no definite conclusion is possible from this work except that at two months the normal is probably over 70 per cent. since the average of the breast-fed infants was 71·4 per cent. at this age, and these were not a selected healthy lot. The author hopes, however, to be able to pursue the question further in the future.

The prevalence of anæmia.

If these conclusions hold good, and the normal after three months of age be taken as 80 per cent., then nearly all the infants in the samples of population examined showed some degree of anæmia. It is true that in many individual cases this was slight, but in a considerable number the hæmoglobin percentage was reduced to three-quarters or less of the normal. This was so in 14 per cent. of all infants at the General Lying-In Hospital Welfare Centre and in 12 per cent. of the artificially fed infants when first seen at the Queen's Hospital for Children and the Bethnal Green Clinic. Examination of the complete figures for the control cases reveals the fact that 25 per cent. of these artificially fed infants fell below three-quarters of the normal hæmoglobin percentage at some time when examined during the first two years of life (see Table A). If, as the author believes, these samples of artificially fed infants are representative of those attending welfare centres, then the great majority of bottle-fed London infants are anæmic.

As regards breast-fed infants, the evidence is less conclusive, but is sufficient to suggest that a very large proportion of these, particularly after eight months of age, are also anæmic. No evidence concerning other areas of the British Isles is given, but the appearance of London infants compared with those in other parts of Britain would not suggest that London is peculiar in its anæmic babies.

Ætiological factors in this type of anæmia.

The hæmoglobin age curve has been shown to have a double drop, the first lasting till two months old, the second beginning about five or six months old. The first drop, like the second, appears lower in artificially fed than in breast-fed infants, and greater in those of low birth weight than in bigger babies; but the present investigation can offer no evidence as to the cause of the first drop.

The second drop, from five months old onwards, can be eliminated by the administration of iron; in fact, the whole level of the curve from four months old can be raised by this means.

What ætiological factors are at work in bringing about the prevalent anæmia in infants from four months old onwards? We are not here concerned with the child who is acutely ill with some septic or other infection, with one of the primary blood diseases, with nephritis or with sarcoma, but with the anæmia prevalent among infants in fair general health. Holt states that the commonest causes of anæmia in young children are "improper feeding, rickets and unhygienic surroundings."

Hygiene. The facts that the disease was shown not to have a well marked seasonal incidence, and that treatment with the mercury vapour quartz lamp had no prophylactic or curative effect, proved that lack of ultra-violet light was not an important ætiological factor. Moreover, outdoor life with the attendant exposure to fresh air and improvement in general health did not cure anæmia which had already developed.

Diet. It is well known that prolonged and exclusive milk feeding and grave errors in diet, such as lack of anti-scorbutic, cause anæmia. This investigation has shown that anæmia develops with many types of feeding in widespread use, e.g., breast milk, fresh and dried cow's milk, with low, medium or high carbohydrate additions, as well as with "humanized" feeds, so that it cannot be said to be associated with any one type of feeding.

Vitamin insufficiency has been suggested as a cause of widespread anæmia, but in the present cases the anæmia could be prevented or cured without altering the quantity of any vitamin in the diet. It developed in spite of the supply of vitamin-A in cod-liver oil, vitamin-D in cod-liver oil and through ultra-violet light treatment, vitamin-C in fruit juice, and vitamin-B and presumably E in a liberal milk allowance. In view, however, of the great emphasis laid upon rickets as a cause of anæmia, it should be stated once more that the incidence of anæmia in the Vienna investigation was not greater in the group of infants developing rickets than in those protected from rickets. Whether vitamin-D deficiency plays a part in the splenic anæmia of infancy is still unknown.

Czerny[14] and others have emphasised that a toxic effect from cow's milk fat plays an important part in the production of anæmia in infants. The present investigation shows clearly that the anæmia under consideration can be prevented or cured without altering the quantity of milk or of milk fat in the diet.

Iron. So much for negative evidence. The positive evidence concerns iron. Its prophylactic and curative effects support the view that deficiency of iron is the main ætiological factor in the anæmia demonstrated to exist so widely in infancy from four months of age onwards. Its administration brought about an increase in hæmoglobin in 81 per cent. of artificially fed infants, and the author's deduction is that all these children suffered from iron deficiency. It is well known that during the period of milk feeding an infant is largely dependent for its iron needs on the store laid down in the liver before birth. In the premature, this store, being very small, is rapidly exhausted; hence the chief cause for the early and severe anæmia which occurs in all premature infants. Is this store deficient also in other infants? Possibly an investigation now in view may give evidence on this point. The greater amount of anæmia present in artificially fed infants than in those of the same type on the breast is presumably associated with the smaller percentage of iron in cow's milk and a smaller percentage retention. This investigation provides no evidence as to whether there is any associated factor concerned in iron metabolism.

Iron treatment of anæmia is, of course, nothing new, but it is not generally known that without iron medication the great majority of artificially fed babies become anæmic, and that with it an improvement can be brought about in over 80 per cent. of such infants.

Effect of iron deficiency on the general health of the infant population.

The administration of iron brought about a striking improvement in the general health of artificially fed infants as evidenced by improved appearance and increased resistance to infection. The statistical evidence as regards weight is not conclusive, but so far as it goes, is in favour of the iron cases. This shows that iron deficiency is at the present time responsible for a great amount of ill-health, and probably for a considerable number of infant deaths resulting from poor resistance. The administration of iron should considerably diminish the yearly toll of deaths from broncho-pneumonia, which is so often secondary to diseases of the upper respiratory tract and bronchitis.

Prophylaxis of anæmia.

Artificially fed babies should be given iron before two months old (see Chart XV), as otherwise the infant will probably develop anæmia. Moreover, the sooner iron therapy is begun the higher the general level of hæmoglobin is likely to be. Iron and ammonium citrate is an effective salt; possibly the poor results recorded from iron therapy in alimentary anæmia by some writers is due to their use of some other less active salt. Iron treatment should be continued throughout infancy as it has been found that omission of iron even for a few weeks may be associated with a drop in the hæmoglobin.

Many breast-fed babies also require iron treatment.

Iron administration to bottle-fed infants on a large scale throughout the country could be most easily carried out by a small addition of iron to dried milk as this form of milk is already very widely used in infant feeding, and by such a method the chances of regular administration are greatly enhanced. This

would bring about an improvement in the health of the infants not less in the author's opinion than that now being brought about by the measures taken for the prevention of rickets.

Summary.

An investigation embracing 541 infants under 2 years of age upon whom 2,561 hæmoglobin estimations were performed demonstrated the following facts:

1. There is a typical hæmoglobin age curve for the first year of life, showing a double drop with an intermediate rise, the first drop during the first two months of life, the second beginning at five months of age (Charts VII and XII).

2. The normal hæmoglobin percentage in the blood in infancy from four months upwards is at least 80 per cent. as estimated by Haldane's hæmoglobinometer.

3. The great majority of artificially fed infants and many breast-fed infants in London are anæmic.

4. Treatment with the mercury vapour quartz lamp, as here given, had no influence in preventing or curing this anæmia (Charts I and III), and no definite relation was shown between seasonal intensity of ultra-violet light and the incidence of anæmia. Outdoor life did not cure it.

5. Anæmia develops in infants on many types of diet, and no evidence was here obtained to associate it with vitamin-deficiency or with a fat-toxæmia.

6. This prevalent anæmia is due to iron deficiency, possibly with some associated factor, and shows itself from about four months of age. It can be prevented or cured by the administration of a soluble iron salt by mouth (Charts XIII and XIV), which raised the hæmoglobin in over 80 per cent. of unselected artificially fed infants.

7. Iron can be satisfactorily and successfully administered in the form of iron and ammonium citrate contained in a dried milk powder, or added in solution to the daily feeds and is excellently tolerated by infants. The percentage of infants reaching 80 per cent. hæmoglobin was eleven times as great in the group receiving medicated dried milk as in the control series (Table B).

8. Iron should be given to artificially fed infants from the first months of life, as the hæmoglobin can thereby be maintained at a higher level than if it is begun later (Chart XV). Its early administration is particularly important in babies who are small at birth (Table A).

9. Artificially fed infants receiving such iron show a striking improvement in general health and resistance to infection (Table E), as well as probably better growth (Table F), as compared to similar infants without iron treatment. The incidence of diseases of the respiratory tract, as assessed by the author was in the iron group only half that in the control group (Table E).

Conclusion. The evidence produced indicates that a marked improvement in infant health and probably also in infant mortality would result from the wide use of dried milk containing a small iron addition, or from the regular administration of an iron mixture, from the early months of life.

The author's gratitude is due to the British Medical Association who rendered this work possible by the grant of the Ernest Hart Scholarship for 1925-26, followed by another scholarship for a second year.

The author is particularly indebted to Miss Lorel Goodfellow who has co-operated in the work throughout and has carried out all the blood examinations. Generous help has also been received from many persons to whom the author offers her very sincere thanks. Professor Major Greenwood, F.R.S., and Miss E. M. Newbold, M.Sc., have examined statistically the children's weights and many of the data on the hæmoglobin of the blood; Sister F. M. Westbrook has had charge of the light treatment and the infants' charts at the Queen's Hospital for the Children, and she and the nurses working with us at the Hospital and at the Bethnal Green clinic have given us their unstinted help throughout the two years of our work.

REFERENCES.

1. Finkelstein, H., *Klin. Wchnschr.*, Berlin, 1911, XLVIII., 1829.
2. Holt, L. E., *Dis of Infancy & Childhood*, Lond., 1926, 693.
3. Hutchison, R., *Lancet*, Lond., 1904, i, 1253.
4. Williamson, C. S., *Arch. Int. Med.*, Chicago, 1916, XVIII, 505.
5. Haden, R. L., *J. Amer. Med. Ass.*, Chicago, 1922, LXXIX, 1496.
6. Stitt, E. R., *Practical Bacteriology, etc.*, Lond., 1923, 289.
7. Griffith, J. P., *N.Y. State J. Med.*, N.Y., 1899, LXIX, 295.
8. Mackay, H. M. M., *Arch. Dis. Child.*, Lond., 1927, II, 231.
9. Haldane, J., *J. Physiol.*, Camb., 1900, XXVI, 497.
10. Barenberg, L. H., and Lewis, J. M., *J. Amer. Med. Ass.*, Chicago, 1928, XC, 504.
11. Mackay, H. M. M., *Lancet*, Lond., 1923, ii, 165.
12. Mitchell, H. S., and Schmidt, L., *J. Biol. Chem.*, N.Y., 1926, LXX, 471.
13. Mitchell, H. S., and Vaughan, M., *Ibid.*, 1927, LXXV, 123.
14. Czerny, A. D., *Rap. Soc. Internat. Péd., Cong. de Paris*, 1912.

APPENDIX I.

STATISTICAL EXAMINATION OF CERTAIN HÆMOGLOBIN CURVES.

By

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Seasonal Variation in Hæmoglobin.

Chart V shows the mean hæmoglobin values for each calendar month of the year separately for babies who had, and who had not, light treatment, and also for both groups combined. There is not much evidence of any seasonal variation, except for some suggestion of lower values in the early summer—especially in May among the light cases. Before testing the significance of this it seemed well to see how much the variation might be due to varying ages and varying lengths of treatment in the values for the different months. Charts IV and VI show the hæmoglobin measures according to age for the two groups and for both combined—the later values with few observations are of course of little value, but the broad resemblance between the light and non-light curves in the first year of life suggests that for the earlier months the shape of the curve is reliable (see the following section). Chart I shows the hæmoglobin measures for varying lengths of treatment. Over the range where there are enough observations the curves are very flat, especially that for light and non-light combined, so that correction for length of treatment would hardly be worth while.

From the figures for the combined age curves, the "expected" values of the hæmoglobin measure for each calendar month were calculated on the basis of the ages of the babies in that month. The deviations of the observed hæmoglobin measure from the "expected" thus calculated were found and are plotted on Charts X and XI. When light and non-light cases are combined there is again little evidence of seasonal effect. When they are taken separately, the light group still shows a low value for May. The mean deviation for hæmoglobin for May is −3·5 but its standard deviation is 1·5, so that it may quite easily be a chance fluctuation from the value −·73 which is the mean deviation for all the calendar months together. Thus unless the suggestion of a drop in the hæmoglobin value in the early summer in light cases is confirmed on other data, we cannot attach any weight to it, as we might on these numbers easily get a variation of this order by chance.

Reliability of the Variation of the Hæmoglobin Level with Age.

The mean values of the hæmoglobin measure for different months of age are given in Table G, also the standard deviation of the observed individual values about these means,

TABLE G. VARIATION OF THE HÆMOGLOBIN LEVEL WITH AGE.

	Light cases.			Non-Light cases.			Light and Non-Light cases combined.		
Ages.	No. of observations.	Mean.	Standard Deviation.	No. of observations.	Mean	Standard Deviation.	No. of observations.	Mean	Standard Deviation.
0–1	—	—	—	2	99·00	9·00	2	99·00	9·00
1–2	3	65·33	2·05	16	73·13	14·81	19	75·26	14·28
2–3	13	64·08	5·61	52	65·46	7·78	65	65·18	7·42
3–4	18	63·56	6·11	46	66·83	6·54	64	65·91	6·59
4–5	23	69·26	5·22	46	69·98	6·66	69	69·74	6·23
5–6	24	69·67	5·77	50	70·92	6·47	74	70·51	6·28
6–7	26	68·73	6·39	52	70·48	5·96	78	69·90	6·16
7–8	27	68·30	5·32	50	69·28	6·46	77	68·94	6·10
8–9	22	69·00	7·09	48	67·90	5·83	70	68·24	6·28
9–10	20	67·45	6·07	42	67·10	7·78	62	67·21	7·27
10–11	17	67·59	6·56	35	64·89	8·42	52	65·77	7·96
11–12	19	66·74	6·58	27	63·41	8·70	46	64·78	8·06
12–13	16	63·56	8·82	29	64·86	8·45	45	64·40	8·61
13–14	11	65·64	—	20	65·90	—	31	65·81	10·04
14–15	12	58·00	—	24	64·21	—	36	62·14	10·19
15–16	13	59·46	—	18	66·00	—	31	63·26	10·27
16–17	11	61·73	—	17	67·35	—	28	65·14	7·90
17–18	5	64·40	—	14	67·07	—	19	66·37	7·40
18–19	5	66·00	—	12	69·08	—	17	68·18	7·90
19–20	4	62·25	—	10	65·70	—	14	64·71	6·91
20–21	4	63·50	—	8	62·63	—	12	62·92	5·53
21–22	3	66·00	—	9	66·22	—	12	66·17	6·93

If σ is the standard deviation of a set of observed values, the standard deviation of a mean of n of these values is $\frac{\sigma}{\sqrt{n}}$ and the probable error $\cdot 67449\frac{\sigma}{\sqrt{n}}$. It is probable that the true mean value lies within 3 times the probable error of the observed mean on either side of it. Charts IV and VI show the mean values for light and non-light, and both combined observed in this sample, and the dotted lines on either side in Chart VI block out the area within which it is probable that the true mean lies. It may be noted that for the first year of life (except the first month) the band of unreliability is relatively small, this is confirmed by the similar course of both light and non-light cases, which is shown in Chart IV. In the second year of life (see Chart VI) the number of cases is too small for any great confidence in the course.

Effect of Light Treatment on Hæmoglobin Level.

Chart IV shows that the course of the hæmoglobin level is very much the same in both light and non-light groups in the first year of life. The differences are within their probable errors. In the second year the cases are too few for a difference to be detected. There is no evidence on these data that light treatment has altered the hæmoglobin level.

* In most cases here we have used the empirical value $\sqrt{n-3}$ instead of $\sqrt{n}$, as when n is small, the usual formula gives too small a value for the s.d. of the mean.

APPENDIX II.

STATISTICAL EXAMINATION OF THE WEIGHTS.

Based on the statistical calculations kindly made by

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The following method was adopted to compare the increase in weight of the group of infants getting iron with that of the control cases:—

(*a*) Taking Griffith's weight curve as the standard of normal, the weight of each infant at the beginning and at the end of the period of observation was expressed as a percentage of the normal.

(*b*) The percentage of relative weight was averaged, (1) for control cases, and (2) for iron cases, for the beginning and for the end of the periods of observation respectively.

(*c*) The difference between the average relative weight at the beginning and at the end of treatment for each group gave the average increase in weight for that group.

Some infants after a period in the control group were given iron (see pp. 133-4). It was found that these infants were, when first given iron, for the most part, older and nearer normal weight than the controls at the beginning of their periods of observation, and their improvement in weight while on iron was considerably less than that of the younger infants whose weight at the outset was much further removed from the normal. In the endeavour, therefore, to obtain a fairer comparison of weights, all infants previously in the control series were excluded from the iron series selected for weight compariosn. The results are shown in Table F. This shows that both as regards age and weight the two groups were comparable at the beginning of treatment, but the period of observation for the iron cases was longer than that of the controls. At the end of the period of observation, the control cases averaged about 87 per cent. of normal weight and the iron cases about 94 per cent.; the iron cases having approached the normal weight curve by 12·35 per cent. and the controls by 6·93 per cent.

THE ASSOCIATION OF PNEUMONIA AND ACUTE BRIGHT'S DISEASE.

By

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It is a curious fact that although acute nephritis and lobar pneumonia are two of the common diseases which we believe are frequently caused, or at least predisposed to, by chill, they should so seldom occur together. This at all events would seem to be the experience of the majority of authors, if one may judge from the evidence of the literature. Many text-books omit any mention of the possible relationship of the two maladies, and do not discuss the influence on prognosis of the one as a complication during the course of the other.

It has, of course, always been recognized that pneumonia developing during the course of chronic nephritis is exceedingly grave, Pye-Smith[1] stating that as a prognostic factor chronic Bright's disease is scarcely less serious than alcoholism. That it is not always fatal under these conditions is admitted and I personally remember one adult with chronic nephritis, who developed the disease as a sequel to lead poisoning, passing successfully not only through one, but several, attacks of lobar pneumonia. The seriousness of this combination is animadverted upon by Rosenstein[2] who states that under such conditions the pneumonia tends to be purulent, and also by McDowell[3] who remarks that it usually becomes gangrenous.

The association of acute nephritis and lobar pneumonia is less frequently remarked upon ; in fact, it is with difficulty that one can find any expression of opinion at all either in text-books or journals.

There are several aspects to the question : the nephritis apparently may be the primary disease and the pneumonia secondary, or vice versa, or the two diseases may be coincident in their onset.

So far as I have been able to discover those authors who have discussed this question have been interested in the presence of nephritis as a complication of pneumonia. They have looked upon pneumonia as one cause of nephritis, and, from its apparent curability, have considered such a nephritis as probably due to the pneumococcus, and as a special and benign type of the disease. In this connection it must be clearly understood what really constitutes nephritis. The mere presence of albuminuria is insufficient, as this is not infrequent from the fever alone, and for the diagnosis of nephritis the presence of albumin in the urine in considerable amount with blood and casts and possibly also œdema is essential. Still[4] records two examples of lobar pneumonia during childhood in which there developed in the course of the disease acute nephritis. Rosenstein[5] also reports two cases of lobar pneumonia, aged 20 and 40 respectively, in which nephritis, as evidenced by abundant albumin, blood and casts, appeared about the 4th day of illness. In all these examples the course of the

pneumonia seemed unaffected and all the patients made complete and speedy recoveries, blood and albumin having completely disappeared from the urine within 6 to 8 weeks. Pye-Smith and Beddard[6] on the other hand say that in pneumonia septicæmic nephritis, which is commoner in children than in adults, is grave and that the mortality is high, though if the case is not fatal the nephritis generally disappears.

It is interesting to note that in none of these cases was there any œdema. This, however, is fairly characteristic of secondary nephritis, at least so far as the diphtheritic and scarlatinal types are concerned.

Apparently no bacteriological examination of the urine was made in any of these cases, at least such is not recorded, and one might raise the possibility of 'pyelitis' or suppurative nephritis being the nature of the complication, and without doubt pyelonephritis and broncho-pneumonia are not infrequently associated, the one or other being the complicating mischief. At one time I considered the presence of casts of great importance in the differential diagnosis between Bright's disease and pyogenic infection of the urinary tract, as in the latter disease casts are seldom met with, and more seldom described. More extended experience, however, has taught me that not only much blood but also numerous renal casts may in the early days of 'pyelitis' be the dominant feature of the urinary picture. There would seem therefore little doubt that pyuria in infancy and early childhood is often of the nature of a nephritis, and a nephritis which is suppurative in character which is the view so ably defended by Chown[7] in a previous number of this journal. Œdema, too, though seldom developing in 'pyelitis,' does so on occasion and hence the differential diagnosis of these two diseases (Bright's disease and 'pyelitis') is at times not a little difficult. In my opinion the urine in Bright's disease is almost invariably sterile so that the recovery of an organism, and especially the *B. coli communis*, from the urine would be of material help in coming to the correct diagnosis.

I think all will agree that as a cause of nephritis pneumonia is rare: most authors, in fact, do remark on the rarity of the association. I personally never remember seeing a case or meeting with an example of chronic nephritis, or at least persistent albuminuria, in which I could trace the origin to pneumonia. This apparent extreme rarity may, of course, be accounted for by the fact, previously remarked upon, that the nephritis under such conditions as a rule rapidly recovers.

The association I specially wish to discuss in this communication is that of pneumonia and acute nephritis in childhood. I will consider it under two headings: (*a*) pneumonia as a complication of acute Bright's disease; and (*b*) coincident pneumonia and acute Bright's disease. Personally, (with the possible exception of Case No. 14), I have had no experience of acute Bright's disease as a complication of pneumonia, the nephritic malady which I have observed complicating pneumonia having been always a suppurative nephritis or pyogenic infection of the urinary tract.

It must be admitted that the association which I am describing would seem to be of a less direct nature and more accidental, but nevertheless it is of considerable interest and importance, standing as it does in marked contrast

to the other both in frequency and in its danger to life. In the case where pneumonia is primary there is possibly a septicæmia, and hence metastatic infection is not surprising and the marvel is, if in pneumonia there is really a septicæmia at any stage, that it should so seldom occur. It may, of course, be another example of the selective action of the organism for one particular organ. Whatever may be the portal of entry in pyogenic infection of the urinary tract, and into this question I do not at present wish to enter, the notable fact remains that the pneumococcus is rarely the ætiological organism.

A.—Pneumonia Complicating Acute Bright's Disease.

The only reference I can find to this association is in Allbutt's System of Medicine (Vol. V, p. 108), where Pye-Smith says that lobar pneumonia occurs both in the acute and chronic forms of Bright's disease. This writer remarks on the more serious prognosis in consequence of their association, but mentions that it is rare in childhood.

During the last 9 years (1919 to 1927 inclusive) there have been observed in the Royal Hospital for Sick Children, Glasgow, at least 11 cases in which pneumonia developed during the course of acute Bright's disease (Nos. 1 to 11 in appendix). When one recollects that there were admitted to the medical wards during the same period in all 219 cases of acute nephritis this incidence (5%) of secondary pneumonia is not inconsiderable.

That the acute nephritis was in existence before the onset of pneumonia is quite apparent from the case histories as summarised in the appendix of this article. In two of the cases the onset of pneumonia occurred after the child's admission to hospital, as can be seen in the accompanying temperature charts.

The interval between the onset of the nephritis and the inception of pneumonia varied between 3 and 14 days, the average period being 6 days.

The type of pneumonia was lobar in 8 cases and broncho-pneumonic in 3.

The outlook so far as life is concerned is apparently much more serious than in either uncomplicated pneumonia or nephritis. Of the 219 cases of acute Bright's disease admitted during the 9 years 1919 to 1927 inclusive, 34 ended fatally during the acute phase of the disease, giving a mortality rate of 15·52 per cent., whereas of the 11 cases complicated by pneumonia 3 died which represents a mortality rate of 27 per cent.

Of the three cases that died the pneumonia was of the lobar type in two and of the broncho-pneumonic in one. It is thus evident that the presence of acute Bright's disease increases considerably the gravity of lobar pneumonia in childhood, which at this period of life is eminently a benign malady. The death-rate of 416 cases of lobar pneumonia during the 9 years under review was 4 per cent., whereas the death rate among the cases complicating acute Bright's disease was 25 per cent. Broncho-pneumonia is always a serious disease, especially when complicated, so that the death rate of 33 per cent., represented by one death in three is not unduly high. One does not, of course, wish to lay too much stress on the above figures as the numbers of cases considered are small.

One of the most striking features of the non-fatal cases was the rapidity with which the nephritis cleared up. In these cases the time which elapsed before all blood and albumin had disappeared from the urine varied between 2 and 8 weeks, with an average duration of 4·7 weeks. This contrasts markedly with the duration of the illness in the average case of uncomplicated acute Bright's disease. During 1927 there were admitted to the wards in the Royal Hospital for Sick Children, Glasgow, 22 examples of this disease. In 10 the condition had quite recovered before dismissal and had lasted for a period varying between 3 and 15 weeks, the average duration being 6·75 weeks. In 12 cases with a residence in hospital varying between 2 and 12 weeks (average 4·5 weeks) the condition had not cleared up.

In the three fatal cases the average duration of the illness was 14 days.

So far as the seat of the pneumonic lesion was concerned there seemed to be no predilection for either lung. In six cases the left lung was involved; the lower lobe was affected five times, and the upper lobe once. In five cases the right lung was the seat of the disease; once the upper lobe, twice the middle lobe and three times the lower lobe.

B.—Nephritis and Pneumonia Coincident.

During the same period, namely 1919 to 1927 inclusive, there were admitted to hospital 5 children (Nos. 12 to 16 in the appendix) in whom nephritis and pneumonia seemed to be coincident in their development: at least from the histories it was impossible to say whether the renal or the pulmonary mischief were primary. These children ranged in age between 3 and 7 years. Three of the patients made a complete recovery and, just as was the case when pneumonia was secondary to the nephritis, the renal mischief was of relatively short duration, all blood and albumin having disappeared from the urine between three and four weeks after its onset.

In two cases the illness terminated fatally. These children were aged 3 and 3½ years respectively. In the elder child empyema and pericarditis were present in addition to the pneumonia. This represents a death rate of 40 per cent, which is excessively high, not only for nephritis, but also for pneumonia, especially at that period of life.

Both lungs and each lobe of either lung were equally frequently the seat of the pneumonic consolidation.

Conclusions.

1. Pneumonia not infrequently develops as a complication of acute Bright's disease.

2. This occurred in 11 (5%) of the cases of nephritis admitted to the Royal Hospital for Sick Children, Glasgow, during the years 1919 to 1927 inclusive.

3. The association of acute Bright's disease and pneumonia increases the death rate of either disease considerably.

4. When the condition does not end fatally the nephritis is unduly short-lived, and clears up rapidly and completely.

5. Pneumonia may also develop coincidently with acute Bright's disease but less frequently than as a secondary complication. This occurred on 5 occasions during 9 years.

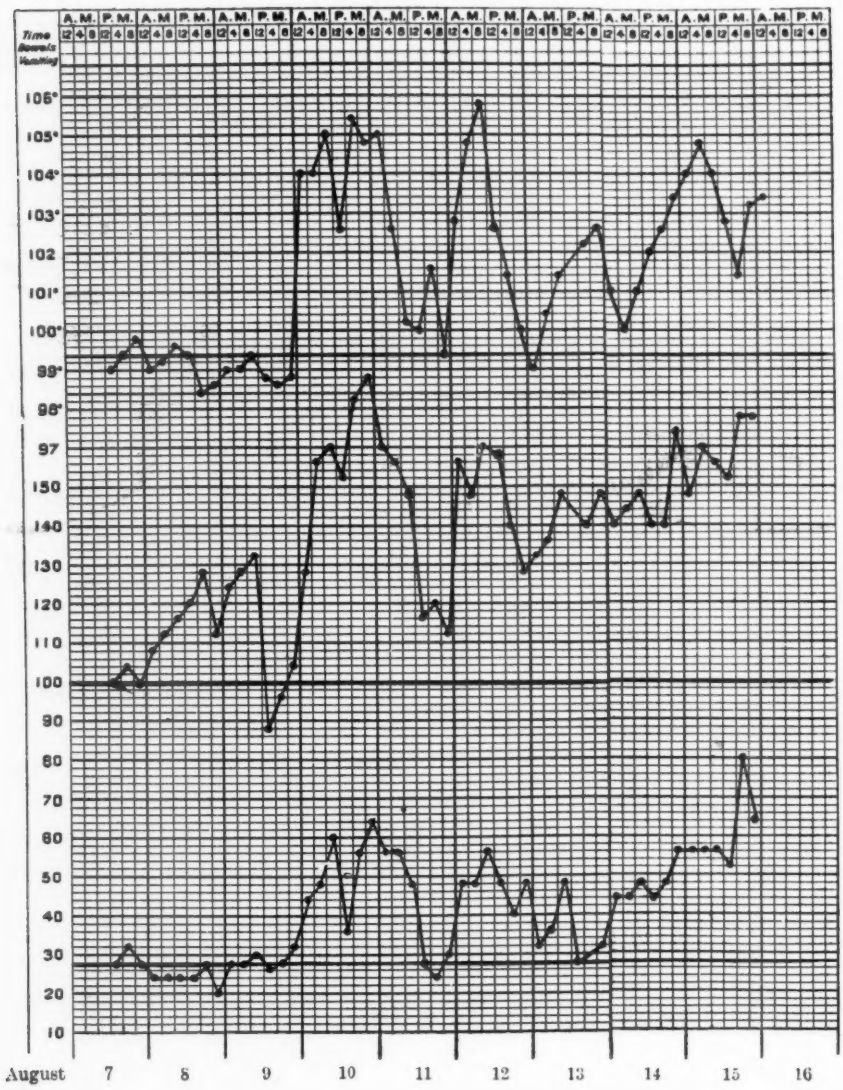
6. This association also increases the gravity of either disease.

7. Though nephritis may also arise as a complication of lobar pneumonia, it does so much more seldom than either of the above sequence of events, as it has not been observed once during 13 years at the Royal Hospital for Sick Children, Glasgow. But according to the literature when it does occur complete and rapid recovery is the rule.

Summaries of Cases of Nephritis followed by Pneumonia.

Case No. 1. (Chart 1.) S. McC., f., *æt.* 5 years, 10 months. Admitted 7.8.23. Took ill day before admission with swelling of face, feet and legs. Nothing abnormal detected about urine. Admitted with normal temperature; œdema of feet and legs and ascites, breathing easy, and chest normal. Urine: albumin and blood present.

Chart I. (Case 1.) Nephritis followed by Pneumonia.



On morning of 4th day of residence, temperature rose to 104° F., respirations to 60 per minute and dullness at left base with tubular R.M. appeared. X-ray examination demonstrated consolidation at left base. Leucocytes 15,400. Fever continued; child got much worse, œdema increased, fluid appeared at left base and child died after 7 days. Blood culture: staphylococci and strepto-diplococci. Fluid from chest: streptococci and pneumococci. No P.M. examination permitted.

Case No. 2. J. G., m., *æt.* 5 years. Admitted 27.5.25. For 3 weeks had not looked well, "yellowish look"; continued at school. Returned from school 6 days ago with headache, vomiting, and face noticed to be swollen; swelling later in evening affected whole body. Vomiting has persisted since 6 days ago. Cough for 4 days.

Admitted with temperature 103·4° F., œdema of face, arms, trunk and legs and generalized cyanosis, cough, respirations 48 per minute, inspiratory dilatation of nostrils; dull left apex, back and front, with moist râles. Urine: albumin and blood present. Fever and rapid respirations continued, also œdema, cyanosis, and consolidation of left apex. Died 3 days after admission. No P.M. examination permitted.

Case No. 3. M. R., f., *æt.* 3 years, 8 months. Admitted 2.2.26. Took ill 2 weeks previously with headache, vomiting and next day œdema of face, with urine scanty, muddy and of reddish colour. Swelling rapidly spread to legs, feet and abdomen. One week later developed cough with dyspnœa. These, as œdema, continued till admission.

On admission temperature 101° F., œdema of feet, ankles and lumbar region, cough, rapid breathing (50), inspiratory dilatation of nostrils, dullness at both bases, generalized wheezing, tubular R.M. and crepitant râles at right base. Urine: albumin, blood and epithelial casts present. Died 2 days after admission.

P.M. Examination: Small amount of fluid both pleural sacs. Broncho-pneumonia both lungs, general. Kidneys swollen, cortex enlarged, mottled due to fatty change, markings irregular. Histologically: glomerular nephritis.

Case No. 4. J. N., m., *æt.* 6 years. Admitted 30.10.19. With exception of measles always well. Took ill 2 weeks previously with vomiting, followed by œdema of face; doctor diagnosed nephritis. Four days before admission cough and dyspnœa.

On admission temperature 103° F., respirations 56 per minute, œdema of scrotum, dullness and tubular R.M. over right lower lobe, and blood, albumin and casts in urine (Esbach ·25 per cent.). Pseudocrisis 3.11.19. Chest explored: mucopus with pneumococci. Temperature normal 6.11.19. Urine clear 19.11.19. Child dismissed well 6.12.19.

Case No. 5. W. K., m., æt. 5½ years. Admitted 6.11.19. Took ill 14 days previously, tired and sleepy and shivered, put to bed. Ten days previously swelling of back, and next day swelling of face, and day later swelling of feet and legs, also frequency of micturition. Sick and vomited day previous to admission.

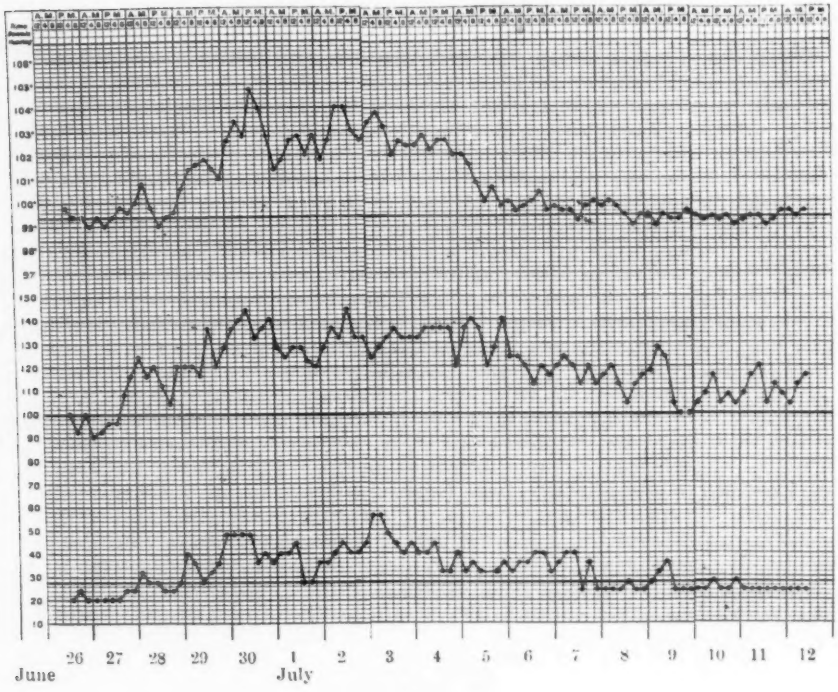
On admission temperature 103·6° F., respirations 40, pulse 116 per minute, slight œdema, dullness over right middle lobe with tubular R.M. Urine: blood and albumin (Esbach U+) and blood casts present. Markedly remittent fever till 10.11.19 when fell by crisis. Albumin persisted till 10.11.19, and blood microscopically till 6.1.20. Child seen 16.11.25 well.

Case No. 6. (Chart 2.) R. E., m., *æt.* 4 years. Admitted 26.6.26. Pneumonia 4 times during first year of life, treated in R.H.S.C., Glasgow. Pneumonia again at 1½ years when resident in Shieldhall Hospital, Govan. Always "chesty," cough and shortness of breath off and on. Last night œdema of legs and face puffy.

On admission œdema of face, legs and lumbar region. Fever with rapid pulse and respiration from 28.6.26 till 6.7.26, consolidation left lower lobe. Urine: blood and albumin, epithelial and granular casts (Esbach 5·5). Blood disappeared 7.7.26. Albumin a haze 9.7.26. Irregular dismissal.

Case No. 7. R. M., m., *æt.* 3 years. Admitted 16.2.25. Fourteen days ago "out of sorts," œdema of face 10 days ago, and urine dark in colour. For 4 days œdema worse and urine very scanty.

CHART 2. (CASE C.) NEPHRITIS FOLLOWED BY PNEUMONIA.



Admitted with temperature 104·2° F., œdema, cough, respirations 50 per minute, dull over middle lobe with tubular R.M. and moist clicking râles, urine contained much blood, albumin and casts. Temperature fell by crisis day after admission. Two days after admission no œdema. Albumin and blood rapidly disappeared from urine, clear by 6.3.28.

Case No. 8. A. McK., f., *æt.* 9 years. Admitted 16.12.22. Twelve days previously complained of pain in stomach, continued at school, few days later again complained of stomach-ache. Eight days ago frequency of micturition and passing of dark coloured urine; severe and persistent vomiting for 5 days; fever and cough for 1 week and dyspnœa for 4 days.

Admitted with temperature 104·6° F., respirations 30 per minute, dull left base with R.M. tubular, and clicking râles. Urine: blood, albumin and casts present. No œdema. Blood urea 30·8 mgrm. per cent. Temperature subsided by lysis and was normal in 4 days. Blood and albumin rapidly diminished, and urine had quite cleared in 2 months.

Case No. 9. M. A., f., *æt.* 4 years, 10 months. Admitted 31.10.23. Swelling of feet 4 days ago; next day child heavy and swelling more marked. One day ago child much worse and at night breathing rapid and laboured with cough.

Admitted with normal temperature, pulse 140, respirations 80, puffiness of face and marked œdema of feet, legs and lumbar region; dullness, tubular R.M. and moist râles at left base. Urine: albumin, blood, epithelial and blood casts present. Slight irregular fever continued for 1 week when respirations became normal in rate. Oedema disappeared in 10 days, blood and albumin rapidly diminished, no blood after 1 week, albumin a mere haze after 10 days; urine sterile.

Case No. 10. C. L., f., *æt.* 2 years. Admitted 18.1.26. Eight months ago swelling of face, hands and feet and scanty dark-coloured urine, treated at out-patient department for 10 weeks. Since then 4 similar attacks each lasting 1 week. Present illness commenced 6 days ago with fever, swelling of face, arms, legs and abdomen, and dark scanty urine; headache for 4 days.

Admitted with temperature 103° F., pulse 140, respirations 48 per minute, œdema of feet and face and consolidation of right upper lobe. Urine contains blood, albumin and casts. Temperature fell by crisis 24th Jan., *i.e.*, 12th day of illness; œdema had disappeared by 28th, and urine was practically clear by 5th Feb. Little blood and albumin after 22nd Jan. Child developed measles Feb. 7th.

Case No. 11. M. McC., f., *æt.* 2 years, 10 months. Admitted 18.11.24. Awoke in morning 2 weeks ago with face swollen; œdema of face diminished but abdomen and feet then became swollen; urinary output scanty; cough for 1 week, dyspnœa and cyanosis for 1 day.

Admitted with temperature 101° F., œdema of feet, legs, back and face, respirations rapid (80), dull left base with intense tubular R.M. Urine: blood, albumin, and epithelial and blood casts present. Fever gradually subsided and was normal by 7th day of residence—œdema all gone by 14th day; urine rapidly cleared, mere trace of albumin and blood after 2 weeks, none on dismissal 6 weeks after admission.

Summaries of Cases of Coincident Nephritis and Pneumonia.

Case No. 12. J. S., f., *æt.* 3 years. Admitted 10.5.16. Took ill 4 days previously with swelling of face and later œdema of hands, feet and abdomen appeared with oliguria.

On admission temperature 104° F., respirations 50 and pulse 140 per minute; generalised œdema; inspiratory dilatation of nostrils; dullness at left base with tubular R.M. Temperature gradually declined as also respiration rate but not pulse rate. Temperature normal 4th day but child died suddenly. No P.M. examination permitted.

Case No. 13. I. McT., f., *æt.* 3½ years. Admitted 9.4.26. Pneumonia twice previously last occasion 7 weeks ago in Isolation Hospital, discharged 5 days ago. Four days ago urine red in colour and scanty with return of cough.

Admitted with fever, 101° F., respirations 44, pulse 140; consolidation left lung; albumin, blood and casts in the urine (Esbach 7). Blood and albumin rapidly diminished and had disappeared by 17.4.26, but fever continued. Empyema and pericarditis (pneumococcal) developed and child died 23.4.26. No P.M. examination permitted.

Case No. 14. J. E., m., *æt.* 7 years. Admitted 5.3.23. Fourteen days previously out of sorts and pains all over body, with cough, put to bed. Three days later face swollen and urine contained albumin and blood. Vomiting for 5 days.

Admitted with subnormal temperature, normal respiration and pulse rates; face puffy but otherwise no œdema; dull left apex with tubular R.M., and urine containing blood, albumin and casts, blood scanty. Blood and albumin rapidly disappeared, no blood after 1 week, mere haze of albumin after 10 days. Never any fever. Dismissed home after 6 weeks well.

Case No. 15. J. L., m., *æt.* 3 years, 10 months. Admitted 9.10.24. Took ill 5 days previously with complaint of abdominal pain, vomited, and urine was noted to be dark in colour. Did not seem fevered. Next day hands and face swollen, seemed to be fevered for 2 or 3 days and was advised by family doctor who had examined the urine to take child to hospital.

On admission normal temperature, pulse 130, respirations 56, œdema of face and shins, dullness right middle and lower lobes with tubular R.M. and râles. Urine: blood, albumin and epithelial casts present. Respirations normal after 5 days, no fever during entire illness. Never much blood or albumin, no blood after 2 weeks and a mere haze of albumin after 2 weeks.

Case No. 16. E. B., f., *æt.* 5 years, 4 months. Admitted 28.8.26. Influenza and pneumonia at 2 years, 4 months. Five days ago listless, 4 days ago vomited, and 3 days ago pain in abdomen. Yesterday face swollen, with scanty urine and heavy rapid breathing.

On admission face puffy, otherwise no œdema, herpes upper lip, impetigo on arms; temperature 103° F., pulse 156, respirations 60; dullness right apex with tubular R.M., abundant albumin (Esbach U+) and blood with blood casts in urine. Temperature fell by lysis and reached normal 1.9.26. Urine cleared quickly; mere haze of albumin and blood by 16.9.26; clear by 23.9.26. Dismissed well 1.10.26.

REFERENCES.

1. Pye-Smith, P.H., *System of Medicine*, Allbutt, Lond., 1898, V, 119.
2. Rosenstein, S., *Pathologie und Therapie der Nierenkrankheiten*, Berlin, 1894, 311.
3. McDowell, B. G., *J. of Med. Sci.*, Dublin, 1856, XXI, 322.
4. Still, G. F., *Common Disorders and Diseases of Childhood*, Lond., 1915, 378.
5. Rosenstein, S., Ibid, 185.
6. Pye-Smith, P. H., and Beddard, A. P., *System of Medicine*, Allbutt & Rolleston, Lond., 1909, V, 229.
7. Chown, B., *Arch. Dis. Child.*, Lond., 1927, II, 97.

PEPTIC ULCER IN THE NEW-BORN.

By

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In May, 1927, a child eleven weeks old was admitted under my care into the Bristol Royal Infirmary suffering from a chronic ulcer of the stomach. At the autopsy I commented to the pathologist (Dr. A. D. Fraser) on the rarity of this condition in my experience, and he replied by showing me a specimen of duodenal ulcer in a child only five days old which he had found at an autopsy not very long before. This stimulated me to further enquiries and I have been surprised at the considerable literature there is on the subject.

The following notes of the case under my care were written by my clinical clerk, Mr. G. L. Ormerod.

Case 1. (*J.A.N.*)

Barbara J., aged 11 weeks, was admitted on May 31st, 1927, with the history that she had been losing weight for two months, and during the past two weeks had appeared to be in pain. For the last two months the stools had been green. On May 30th, she vomited at 4 a.m. and again in the early morning of the 31st. During these two days the stools were black instead of green.

The child was the youngest of five, the others being healthy, as were the parents. She was breast fed for 8 weeks and was then put on to Grade A milk with equal parts of water. Her weight at birth was 7½ lbs.

On admission she presented the appearance of a very pale, small, and silent infant with long soft hair. She weighed 5 lb. 8 oz. Her pulse rate was 120, temperature 97·2°, respirations 32. On the night after admission the child vomited, and passed black stools.

On June 2nd the note reads "vomited again three times yesterday immediately after food and still has melæna."

Apart from her appearance there was nothing abnormal discovered on examination of the child. The liver was not enlarged, the heart and lungs were normal and there were no hæmorrhages elsewhere. But the note says "there is an organ in the abdomen which feels like an enlarged stomach." This suggested hypertrophic stenosis of the pylorus, but no visible peristalsis was seen and no pyloric tumour was felt.

The melæna continued but the vomiting lessened. On the 6th I gave her small doses of belladonna with her feeds and this seemed to check the vomiting. On the 8th the note

reads, " still losing weight (5 lb. 2 oz.). She has vomited brown stuff and had melæna yesterday ; she is extremely pale." On the 9th she died.

P.M. Examination : There was marked œdema of the lungs and clear fluid in all the serous cavities. There was a little fresh blood in the stomach and black fæces in the intestine. On the posterior aspect of the cardiac orifice of the stomach there was an ulcer measuring 1·8 by 1·3 cm. situated half within the stomach and half in the œsophagus. The edges of the ulcer were terraced and the surrounding wall was fibrotic and thickened. The base was formed of adherent diaphragm muscle. A small eroded vessel could be seen at the pyloric end of the ulcer where the edge was undermined. Diagnosis : chronic peptic ulcer.

From the situation of the ulcer it is unlikely that any surgical operation could have relieved the condition.

Case 2. (*A.D.F.*)

Female, aged 9 days. For three days before death the child was blue in colour, and there was hæmorrhage from the nose and vulva, and melæna.

P.M. Examination : There was a congenital malformation of the heart. In the duodenum midway between the pylorus and the opening of the common bile duct there was an ulcer measuring 1·6 by 0·8 cm., the edge of this ulcer was irregular and hæmorrhagic but not terraced. Ulceration had penetrated to the subperitoneal layer which formed a clean but slightly bile-stained base. There were no adhesions. Here and there along the small intestine there were small submucosal hæmorrhages, but no ulceration. Diagnosis : acute peptic ulcer.

Discussion.

As regards situation I have only found one instance recorded similar to Case 1, namely, that published by Henoch[1], and prefaced by the following words : ' This case stands quite alone.'

A child of 5 days, admitted 1st October, 1883. Since the third day of life, repeated vomiting of blood, with black bloody stools. The child sickly, shrivelled and anæmic. Extremities cold. Anal aperture covered with bloody fæces. Pulse imperceptible ; temperature 87·8°. Takes no nourishment. Death that evening.

Autopsy : General anæmia. Spleen normal. Immediately over the cardia a ring of ulceration 1⅝ inches long surrounding the whole œsophagus. The submucosa remained free. It was swollen and infiltrated with greyish white mattèr. The ulcer was sharply defined above. Otherwise everything normal. " We were unable," writes the author, " to throw any light upon the origin and nature of this œsophageal ulcer."

Henoch's case was one of acute ulcer, and perhaps acute ulcers of the stomach, duodenum and even of the œsophagus, are not so very rare.

Cruveilhier[2], who is credited with having given the first description of the round ulcer of the stomach, illustrates in his *Anatomie pathologique du corps humain* (Paris, 1829-1835) ulceration of the stomach in the new-born. His figures represent the stomachs of new-born infants on the eighth and fifteenth days and one month after birth respectively. In each case the ulcers are multiple. In the third case he states that black vomiting had taken place. He goes on to quote Billard[3] and agrees with him that a follicular ulceration of the stomach occurs in infants which may produce ulceration in a few days.

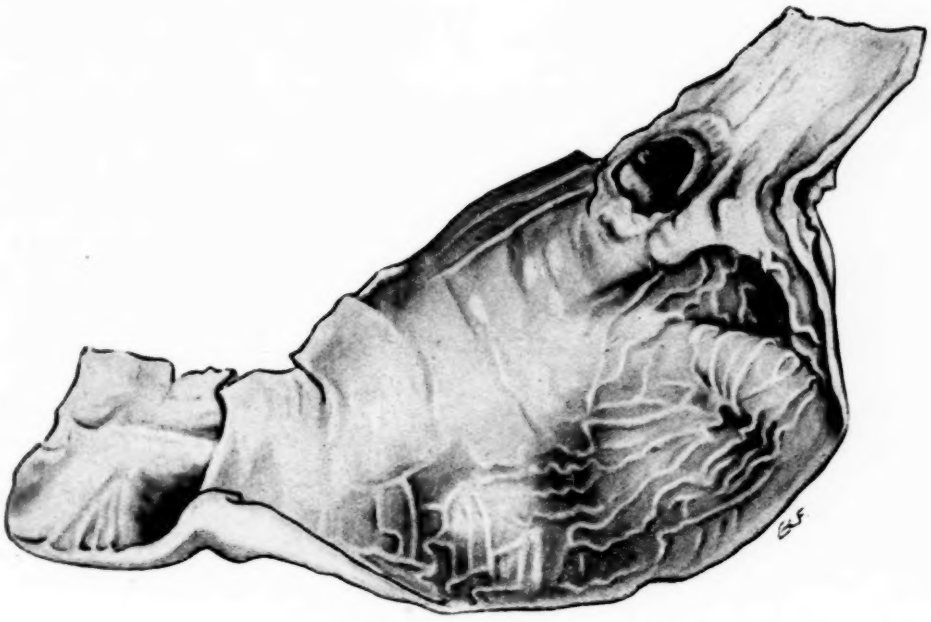

Fig. 1. Post-mortem appearance in Case 1.

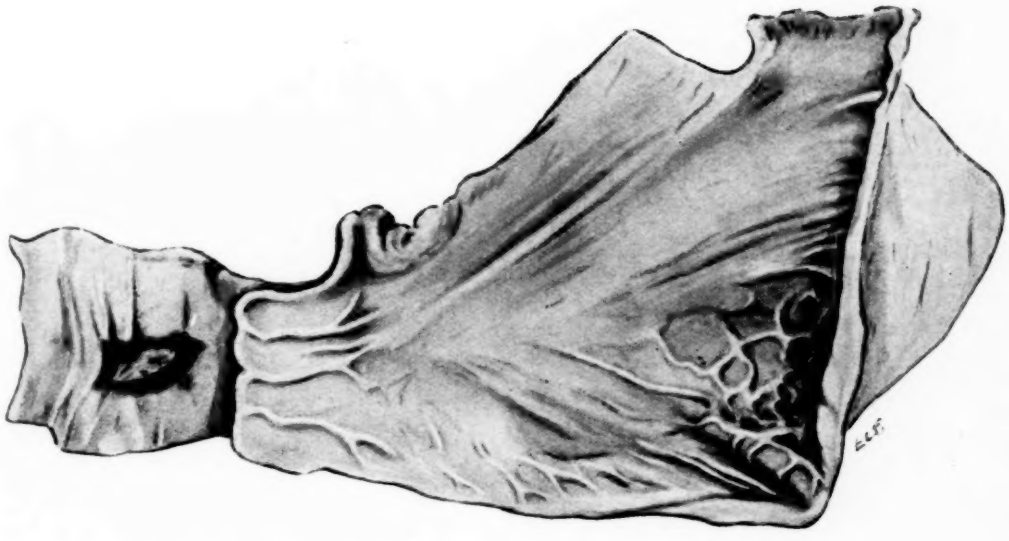

Fig. 2. Post-mortem appearance in Case 2.

Billard considered these ulcers not uncommon and accounted for them by saying ' if there should occur ever so little disturbance in the general or pulmonary circulation the abdominal vessels become engorged, a passive hæmorrhage occurs.'

Landau[4] published in 1879 a book on 'Melæna in the New-born' which is one of the great contributions to our knowledge of these ulcers. His conclusions are important :—

1. Almost all cases of uncomplicated melæna in the new-born depend on round ulcer of the stomach or duodenum.

2. They are due to injuries of some kind during birth, especially asphyxia.

3. Gastric and duodenal ulcers are commoner than is usually supposed ; as in adults, girls are more liable to be affected than boys.

4. Melæna without ulceration is due to the same causes, asphyxia, pressure, &c.

Silbermann[5] in 1877 related two cases he had seen, and collected reports of 42 others. His conclusions are similar to Landau's :—

1. Melæna depends without any doubt on ulceration.

2. He agrees with Landau as to the causes, namely embolus, thrombosis and above all asphyxia.

3. Extravasations of blood take place during suspension of breathing and this explains cases where there is an ulcer but no embolus is found.

Silbermann finally mentions cases where melæna depends on such causes as disease of the liver and spleen, atelectasis of the lungs, high aortic pressure, hæmophilia and infections.

Kundrat[6], writing in Widerhofer's article on 'Gastric and Intestinal Hæmorrhage' in Gerhardt's Handbuch der Kinderkrankheiten (Vienna, 1879), surveyed the whole subject. In the main his conclusions are identical with those of Landau and Silbermann, but he adds the remark that the group of cases of melæna neonatorum with ulcers in the stomach or duodenum are usually asphyxiated.

The English authors, Charles West[7] and Eustace Smith[8], were of substantially the same opinions.

Widerhofer[9] thought that the prognosis in cases of melæna neonatorum was very grave. According to his researches 50 to 60 per cent. of all cases of melæna were fatal, and death was inevitable in all cases with ulcer.

The frequency of the occurrence of melæna in the new-born is given by three authors thus : Hecker found it in 8 cases in 4,000 births, Genrich 1 in 1,000,

and Moynihan[13] 1 in 1,000, and the last named author adds, 'not all of these are due to ulcer.'

These observations would scarcely be of more than academic interest if gastric and duodenal ulcers in infancy were only discoverable on the post-mortem table, and if treatment were impossible or hopeless.

Diagnosis.

As regards the diagnosis of these ulcers, apparently they occur in marasmic infants either as the cause or as the result of the marasmus; therefore we might justifiably suspect ulcers more commonly in marasmic babies than we do at present.

Melæna in the new-born may be almost the only sign of ulcer, but Widerhofer sounded the warning that bleeding may be absent, as it was in the early stages of my case. In any event Widerhofer's advice is sound, that the quantity of hæmorrhage has no bearing on the diagnosis of ulcer. 'We have seen,' he wrote, 'the amount equally great in cases where there was no ulcer. On the other hand continuous bleeding (over 36 hours) increases the likelihood of ulcer.' Marasmus must not, of course, be expected in those cases where death occurs in the first few days of life. If the infants live longer they may show signs of pain associated with food. Vomiting seems usual either after pain or after diarrhœa. Armitage[15], who states that melæna occurs in 40 per cent. of cases, noted that diarrhœa was reported in 50 per cent. of acute cases. Hæmatemesis may, or may not, occur: its absence indicates nothing.

Kundrat[6] observed that just as in adults so in infants ulcer of the stomach may be acute or chronic. He attributed both forms to minute hæmorrhages. The difference between mere erosion and definite round ulcer is, he said, quantitative not qualitative.

During life the distinction between acute and chronic ulcer can scarcely be based on anything except the duration of symptoms.

Proctor[11] has collected all the accounts of chronic peptic ulcer in children that he could find in the literature. His list extends to 19 undoubted cases and 2 doubtful. The ages of 17 out of the 19 cases ranged from 5 to 14 years and are outside the scope of this paper. His two remaining cases seem clearly to fall within the category of peptic ulcers in infancy.

Alsberg[12] in 1920 published the case of a girl aged two years who had a sudden attack of pain and bleeding. Operation revealed the bowels to be full of blood and an old duodenal ulcer scar near the pylorus, with adhesions to the liver. The child recovered. Palmer's case referred to below was the second of the same sort.

Moynihan collected records of chronic duodenal ulcer in thirteen infants whose ages lay between six weeks and ten months. Veeder[16] mentions five cases

ranging in age from one month to five months. In each of these cases marasmus and vomiting were prominent symptoms. Veeder concludes that when massive hæmorrhage from the bowel accompanies these symptoms the diagnosis of duodenal ulcer suggests itself strongly.

Treatment.

In the acute cases ordinary medical treatment may suffice for cure. We know that such a condition can heal from the account of Palmer's[10] case where a boy six months of age was operated on who had had symptoms from birth. At the operation a scarred ulcer was found in the duodenum. This boy had first a pyloroplasty and later a gastro-enterostomy performed. At the age of two years he was reported to be normal.

Note by A.D.F.

The ætiology of peptic ulcers in infants is unknown. The histories of the published cases of hæmatemesis and melæna neonatorum suggest that interstitial hæmorrhage may be the primary factor in the causation of the ulcer, for in many cases the labour has been a difficult one and respiration has had to be stimulated. Support is gained for this view by the two cases reported. Case 1 was born after a prolonged labour and Schultze's method was used to start respiration. Case 2 demonstrates peptic digestion of an area of tissue devitalised by hæmorrhage—the hæmorrhage occurring during asphyxiation. Such hæmorrhages occurring in the new-born are likely to be extensive, since most infants for the first few days of life are potential bleeders. This, as Lucas[11] has shown, is due to a temporary deficiency of prothrombin.

Conclusions.

The conclusions which may be drawn from these observations are :—

1. That peptic ulcers are commoner in infants that is commonly recognised.
2. That melæna neonatorum depends not infrequently upon ulcer of the stomach or duodenum.
3. That acute ulcers may heal spontaneously or as the result of medical treatment.
4. That the existence of chronic peptic ulcer may be suspected in marasmic infants who vomit frequently, who appear to suffer pain after food, who pass blood from the bowel, and, more rarely, who vomit blood.
5. That some cases of chronic peptic ulcer can be cured by surgical operation. I have particularly insisted that only " some cases " may be successfully operated upon because from the situation of the ulcer in Henoch's case and in my own (where the œsophagus was involved) there would seem to be small likelihood that any operation could have been performed with success.

REFERENCES.

1. Henoch, E., *Lect. on Child. Dis.*, Lond. 1889, I, 69.
2. Cruveilhier, J., *Anat. path. du Corps hum.*, Paris, 1829, XV, Pl. 3.
3. Billard, C. M., *Dis. of Infants* (Eng. trans.), Lond. 1842, 247.
4. Landau, *quoted by* Widerhofer (*v. infra*).
5. Silbermann, O., *Jahrb. f. Kinderheilkunde*, Berlin, 1877, XI, 378.
6. Kundrat, *with* Widerhofer (*v. infra*).
7. West, C., *Lect. on Dis. Inf. & Child.*, Lond., 1848, 372.
8. Smith, E., *Dis. of Children*, Lond., 1889, 2nd Ed.
9. Widerhofer, H., *Gerhardt's Handb. d. Kinderkrank.*, IV, ii 400.
10. Palmer, D. W., *Ann. Surg.*, Philad., 1921, LXXIII, 545.
11. Proctor, O. S., *Surg., Gyn., Obs.*, Chic., 1925, XLI, 63.
12. Alsberg, J., *Arch. f. Verdauungskr.*, Berlin, 1920, XXVII, 396.
13. Moynihan, B., *Duodenal Ulcer*, Lond., 1910.
14. Lucas, W. P., *et al.*, *Am. J. Dis. Child.*, Chic., 1921, XXI, 96.
15. Armitage, H. M., *Ann. Surg.*, Philad., 1927, LXXXV, 632.
16. Veeder, B. S., *Am. J. Med. Sc.*, Philad., 1914, CXLVIII, 709.

DUODENAL ULCERS IN TWO INFANTS OF THE SAME FAMILY.

BY

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Duodenal ulcers are not a common event in young children and therefore I think that the occurrence of the lesion in two successive infants in the same family is worthy of record.

So far there have been three children in the family: the first, now aged six years is alive and well. The second child died at the age of two months in the Royal Hospital for Sick Children, Edinburgh, and the details were reported by J. A. L. Loudon[1] in 1925. My case, the third child, was admitted to the Dundee Royal Infirmary in a dying condition early this present year, and was found to be suffering, like the Edinburgh infant, from a duodenal ulcer which was the immediate cause of death.

These two cases present some points in common and some of difference. The Edinburgh infant was a small baby weighing at birth 6½ lb. and never throve. The baby was breast fed for two weeks, and then on a varied assortment of artificial foods. Vomiting was frequent, and wasting, at first gradual, then rapid, soon produced a serious condition. Three days before death a brown stool was passed in which altered blood was found. On the following day a typical melæna stool was passed, and though on admission to the Royal Hospital transfusion was at once performed, there was further hæmorrhage, and death occurred on the next day. At the post-mortem examination an acute ulcer was found, ½-cm. from the pylorus, on the posterior wall of the duodenum, and another smaller ulcer on the anterior wall.

The child whom I saw was admitted to the Dundee Royal Infirmary on February 5th, 1928, at the age of seven weeks. At birth it weighed 10 lb. and for a week appeared to be healthy. Then for six or seven days there was a little brown vomit each day. Breast feeding was in consequence abandoned and a constantly changing succession of artificial foods was tried. After the first vomiting there was no recurrence, but there was incessant crying, and green stools without blood in them were frequent. The child rapidly wasted so that by the time of its admission its birth-weight of 10 lb. had sunk to 6½ lb. The Wassermann reactions both of the child and its mother were negative; there was no peculiarity in the blood-count and the stools betrayed no sign of bleeding.

An X-ray examination showed a somewhat dilated stomach, which emptied at a normal rate: in 3½ hours the whole meal had passed into the bowel.

The history of the previous child, together with the story of the brown vomit, suggested the diagnosis of a duodenal ulcer. In spite of treatment death took place on February 10th. A post-mortem examination revealed the presence of three ulcers, one the larger on the posterior surface of the first part

of the duodenum, ½-cm. from the pyloric sphincter, and two smaller ones opposite on the anterior surface. The larger ulcer was punched out and had penetrated the muscular coat ; the two smaller involved the mucous membrane alone. The microscopic examination of the ulcers showed nothing remarkable ; there was no sign of round-cell infiltration and no fibrosis.

Discussion.

Duodenal ulcers in infants have long been known especially as post-mortem phenomena in the disease known as 'melæna neonatorum,' but of recent years they have been reported much more frequently, especially by the American pædiatricians. Theile[2] in a monograph on gastric and duodenal ulceration in infancy and childhood, published in 1919, was able to collect 64 cases of gastric or duodenal ulceration in children dead of melæna, 31 of which were duodenal.

Fig. 1.
In the first part of the duodenum one large ulcer is seen and two small ones lying below it.

He also showed that they were almost as frequent in marantic infants who had not shown any signs of melæna, and gives details of 48 cases. Together with more recent cases recorded in America there are in all some two hundred cases on record. I have not been able to find any record of successive infants in the same family. In all these records the ulcers have always been in the first part of the duodenum and most often on the posterior wall. They are never found below the ampulla. They do not show signs of round-cell infiltration, nor of induration, and are usually of the punched-out variety. Very rarely a perforation of the ulcer has been the immediate cause of death.

Of course the suggestion has been made that these ulcers are not the cause of the ill-health and wasting, but are the result, that is are secondary and terminal conditions. This contention is probably true of some cases, yet it is

difficult to resist the conclusion in other instances that they are at least the primary cause of the fatal termination.

Let us look at some of the hypotheses as to the cause. First, that the ulcers are of infective origin, streptococci and their toxins producing an area

Fig. 2.

Arterial Supply of the First Part of the Duodenum; showing Supra-duodenal Artery arising from the Right Hepatic Branch (after Prof. Wilkie).—Supra-duodenal artery supplies upper one-third of the anterior surface, and upper one- to two-thirds of posterior surface. Branches from the pyloric artery in 50% supply first ½-in. of upper border and adjacent parts of anterior and posterior walls. Recurrent branch from either R. gastro-epiploic or sup. pancreatico-duodenal artery supplies lower one-third of anterior surface of first inch of duodenum. Retro-duodenal artery, branch of gastro-duodenal artery, supplies lower two-thirds of posterior surface. Branches from sup. pancreatico-duodenal artery supply termination of first part of duodenum: anastomosis between those and ones mentioned above is by no means free.

of necrosis, and auto-digestion leading to ulcer. Secondly, that there is a focal sepsis, and infection is carried direct by the blood-stream. Thirdly, that there is thrombosis, due to the great feebleness of the infant. In considering these hypotheses one must remember the fact that the ulcers are situated in the first part of the duodenum above the papilla. The suggestion is that the acid gastric juice is squirted on to the first part of the duodenum, and produces an ulcer, and that the duodenum below the papilla is protected by the alkaline bile and pancreatic juice. Braithwaite found that if the papilla were transplanted to a lower position, ulceration took place in the lower half of the duodenum.

I believe that I am right in saying that in health the acid gastric juice impinging on the duodenum will not produce an ulcer, and I venture to suggest another explanation of the cause and position of these ulcers.

First let me take one or two points of anatomy in regard to the position and blood-supply of the duodenum. The text-books of anatomy fully describe the surface markings and the normal position of the duodenum. It is, however, well known that there is no normal position of the stomach and duodenum; and though it is stated that the duodenum has a mesenteric attachment of the first part only, one will often find on careful examination that it has a complete mesentery. Mr. Taylor, one of the Assistant Surgeons at the Dundee Royal Infirmary, out of his accurate knowledge of anatomy, has several times demonstrated this fact to me.

Next look at the blood-supply. Wilkie of Edinburgh has thoroughly explored this region. He describes an artery not mentioned in the text-books, which he has termed the supra-duodenal artery. This has a varying origin and supplies the upper two-thirds of the anterior surface and the upper one- or two-thirds of the posterior surface of the first part of the duodenum. This artery is small and is in addition practically an end-artery, with little or no anastomosis between it and the pyloric. In wasted children with great muscular enfeeblement and laxity of ligaments there is a possibility of dragging down of the abdominal organs, and this might cause the supra-duodenal artery to be put on the stretch, thus narrowing or obliterating its lumen and causing a necrosis of the tissue supplied.

Lastly, I may add a few words about the diagnosis of these ulcers. At present the majority are diagnosed in the post-mortem room. In the case of adults there has been a progressive improvement in the diagnosis of duodenal ulcer. Is there a possibility that a similar improvement may be attained in the case of infants now that we are aware that the presence of ulceration is by no means an uncommon event?

At present the only guide that we have is the presence in the vomit or the stools of blood, together with marked and progressive wasting. In adults the information which can be obtained from an accurate history is probably one of the safest guides; the indigestion, the periodicity and the definite cycle of pain. In infants one is denied this help. The child is often fed irregularly and on odd materials, and the pain of hunger especially and that due to the existence of a duodenal ulceration, are indistinguishable. The

vasosensory and vasomotor reflexes are in the infant, to me at any rate, of no assistance. X-rays so far have not helped me. Appearances vary much even in health ; the duodenal cap is not formed in infants, and, the ulcers being small and acute, there is neither deformity nor residue of barium in the ulcer.

Yet all our information goes to prove that we have in duodenal ulcer a real clinical entity, and probably with more accurate observation we shall be able to make in the near future an earlier diagnosis. Neff[3] has recently stated that successful gastro-enterostomy has already been formed in some such cases, but gives no reference to support his statement.

REFERENCES.

[1] Loudon, J. A. L., *Lancet*, Lond., 1925, i, 605.
[2] Theile, P., *Ergebn. der Inn. Med. und Kinderheilkunde*, Berlin, 1919, XVI, 302.
[3] Neff, F. C., *Clinical Pediatrics*, N. Y., VIII, 147.

HYPERTELORISM: An Unilateral Case.

BY

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Ocular hypertelorism has been defined by D. M. Greig,[1] who was the first to differentiate this condition, as a congenital cranio-facial deformity produced by abnormal development of the portion of the sphenoid which is laid down in cartilage. This mal-development results in the formation of great wings which are under-sized, while the lesser wings are as big as, or bigger than, the great wings. The facial appearances are characteristic. They consist in wide separation of the orbits, a broad nasal bridge, and external strabismus. The head is brachycephalic with flattening of the occiput and bulging of the temporal regions. Mental deficiency is a feature of the cases, at any rate of the severe ones.

Greig was prepared to admit the possibility of ocular hypertelorism occurring as a unilateral deformity and in an addendum to his paper he writes as follows :—

> Perhaps the following may not be irrelevant. In 1890, as a variety of plagiocephaly, Fridolin[2] described the skull of a boy aged 3 months. It was asymmetrical, high and short, and the right side flatter than the left. The frontal and parietal eminences were absent from the right side, and the upper two-thirds of the right half of the coronal suture were synostosed. In my opinion the partial synostosis and the absence of the right parietal and frontal eminences are related to each other, the synostosis having prevented their development, and, an unwonted strain being thrown on the anterior fontanelle, a large inter-sutural bone has been the result. This part of the deformity is not uncommon, and has no particular relation to hypertelorism, but the other part of the deformity present has; and the presence of two defects in the skull need excite surprise no more than the co-existence or multiplicity of congenital defects elsewhere.
>
> The right orbital cavity is higher and narrower than the left, and the distance between the eyes in in consequence increased. The right orbital index is 155, the left is 84. In the right temporal region the great wing of the sphenoid is much narrower than in the left, the measurements being respectively 3 mm. and 11 mm. The right zygomatic bone is higher than the left, and the zygomatic arch is shorter. The right side of the root of the nose is 54 mm. from the acoustic meatus, the left is 69 mm. from the corresponding point on the left side . . . .
>
> It is obvious that synostosis of part of the right side of the coronal suture could not explain all these defects which are entirely unilateral. It is not difficult from what we have seen in hypertelorism to visualize the right side of the skull Fridolin so minutely describes. Further, if one can imagine the deformity as bilateral, the similarity to hypertelorism will be at once recognised and the fault ascribed to the sphenoid, especially that portion of its greater wings which is developed in cartilage. The explanation I have given of hypertelorism makes a unilateral affection not only possible but probable.

Enough has been quoted to show how completely D. M. Greig anticipated the existence of unilateral hypertelorism, and Fridolin's description can be compared with the features of the case of unilateral hypertelorism described in this paper.

Description of Case.

Winifred B., aged eight years, is the last child in a family of five. The other four children are of normal appearance. The first is a girl of twenty-three; the next is a boy of twenty-one, said to be the subject of renal trouble; the third (a girl) died of pneumonia; the fourth, a girl of fifteen, is of small stature but otherwise normal. Winifred was born when her mother was forty-two. Although labour was prolonged no instruments were employed. There have been no miscarriages. Both mother and father come of normal families.

Winifred was brought to the Children's Department at King's College Hospital because she held her head on one side, and it was found that she had a torticollis, probably of ocular origin.

Facial Appearance.

The general facial appearance is shown by the photograph (Fig. 1). The upper part of the face on the right side is flattened and the right supra-orbital margin is underdeveloped. The right eyebrow is somewhat higher than the left, and the right palpebral fissure is wider than its fellow. It appears on close examination that the right orbit is displaced outwards and a little upwards. In consequence, the nasal bridge is wide; the distance between the inner canthi is 34 mm. The inter-pupillary measurement could not be taken accurately on account of an alternating strabismus, but an approximate measurement of 60 mm. was made. The distance between the external canthi is 86 mm.

With the object of demonstrating more fully this facial asymmetry the photograph reproduced in Figure 1 was enlarged and two right halves made into one picture (Fig. 2) and two left halves into another (Fig. 3). Figure 2 gives the appearance of separation of the eyes and breadth of the nasal bridge characteristic of hypertelorism, while Figure 3 would pass for the photograph of a normal child.

Description and Measurements of Head.

The presence of hair made accurate head measurements difficult. The maximum horizontal circumference (measuring round the most prominent parts of the glabella and occiput) is 514 mm. ($20\frac{1}{4}''$). The greatest length (from the most prominent part of the glabella to the most prominent part of the occiput) is 197 mm. ($7\frac{3}{4}''$). The greatest parietal breadth is 168 mm. ($6\frac{5}{8}''$) but a longer measurement was taken from a point above and in front of the left ear to a point above and behind the right ear ($6\frac{3}{4}''$). These measurements give a cephalic index of 85 and the skull is brachycephalic. There is very well marked flattening of the occipital region on the right side but none on the left.

Orbits and Eyes.

That the orbital measurements differ on the two sides is beyond doubt but such accuracy as is obtainable in the macerated skull, is not possible. On the right the orbital height is 34 mm. and the greatest width 33 mm., giving an orbital index of 103. On the left the orbital height is 31 mm., and the width 37 mm. giving an orbital index of 84.

Dr. Whittington, who has examined her eyes, reports, "Compound hypermetropic astigmatism for which she wears glasses. Has alternating concomitant external strabismus and does not fix a near object with both eyes. The right eye tends to diverge most with the screen test and turns a little upwards as well as outwards, but the right eye is the fixing eye of choice under ordinary circumstances. The vision of the left eye is the worse of the two, and the tendency to turn the face to the left and to tilt the head to the left is probably associated with faulty vision and defective muscle balance. Discs normal."

General Condition.

This little girl is a healthy and not unattractive child. Examination of the nervous system and visceral organs yields no abnormality. There is slight webbing of the second and third digits on each foot. There is the slightest suggestion of incurving of the little fingers but neither the hands nor feet are mongolian in character. There is no acrocyanosis.

Mental Condition.

Her mental condition is reported on by her teachers in the following words :

(Infants School) : " She was admitted at the age of five. During her first year her general progress was rather slow owing to timidity, but later she attained a good average degree of proficiency."

(Girls' School) : " She is below average in ability, but she has made great progress in reading and writing. Arithmetic she finds very difficult. She is a quiet little girl but is very interested in all school work."

On examination by the Binet-Simon tests Dr. N. H. M. Burke says of her : " This child is bright and intelligent in manner. She shows failure in tests requiring understanding of imagery and relationships. Observation, attention, and memory are good, and the general intelligence

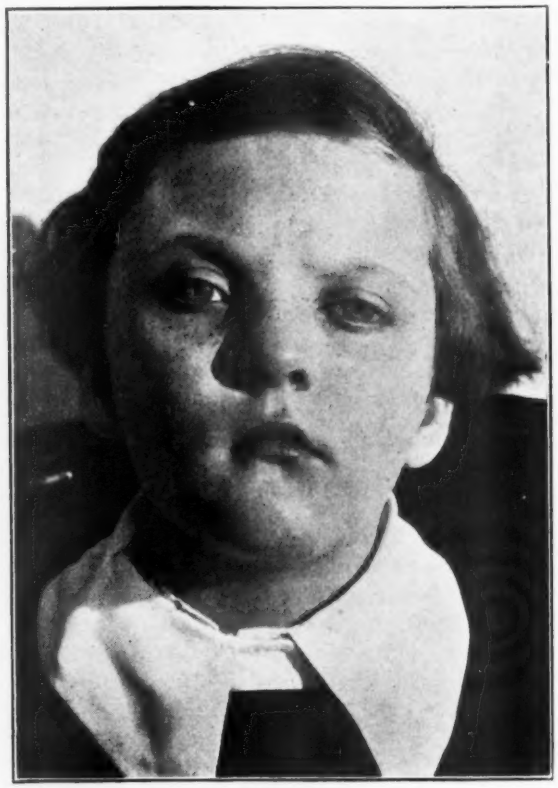

Fig. 1.—Unilateral hypertelorism.

is well above the average. Her mental age is 9½ years, giving an Intelligence Quotient of 117%." Thus the slight backwardness reported by the school teachers is not confirmed by the Binet-Simon tests.

Radiological Examination.

The radiological appearances are, in our opinion, inconclusive. The two sides of the skull are obviously not symmetrical, and there is definite bulging of the temporal region on the right side. The sella turcica is normal.

Discussion.

In the case of Winifred B., we have an unusual ophthalmological condition to explain, namely, the occurrence of hypermetropia with external strabismus. It is well known that hypermetropia is usually associated with internal

strabismus. For an exception to this rule there are two theoretical explanations forthcoming. First, that a lesion of part of the third nerve nucleus may cause weakness of convergence. This, for example, is what occurs in the post-encephalitic state following encephalitis lethargica. Thus, Dr. T. H. Whittington found that among 100 post-encephalitic children there were eighteen cases of external strabismus and no cases of internal strabismus, although among unselected children internal strabismus is the commoner type of squint. It is reasonable to assume a partial lesion of the third nerve nucleus in these post-encephalitic children. Secondly, that a developmental defect of binocular

Fig. 2.
Two right (hyperteloric) halves made into one picture. Note the widely separated eyes and width of nasal bridge.

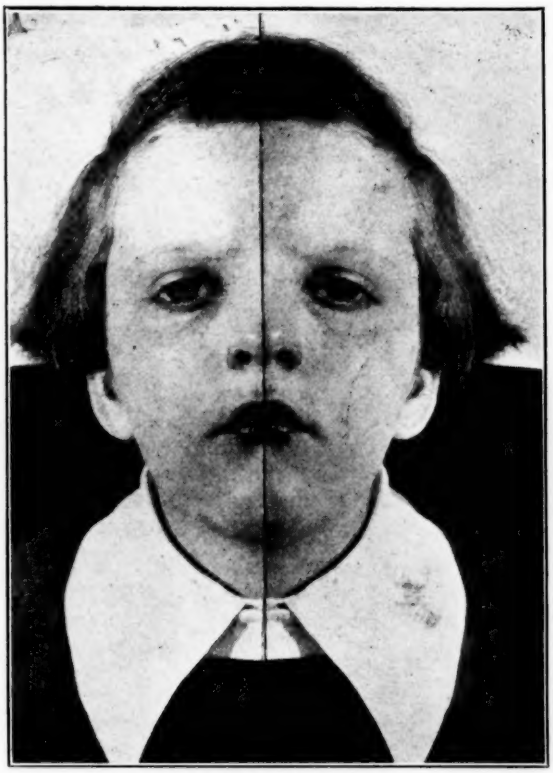

Fig. 3.
Two left (non-hyperteloric) halves made into one picture.

vision and the fusion centre* may occur. This is the explanation which seems more probable in the case under discussion. If hypertelorism is atavistic it would be expected that, together with the lateral displacement of the eyes, binocular vision would be absent. This, in fact, is the rule in hypertelorism and explains the ocular condition in the present case. Greig describes one of his cases in the following words: "Her eyes did not converge on near objects. Like a hare, she could not see objects directly in front of her so readily or so well as when they were placed laterally or when she turned her head away

* A fusion centre has been postulated by Worth but proof of its existence is wanting.

from them." Binocular vision is a recently acquired characteristic of man. Birds and many quadrupeds have laterally placed eyes. The horse is in an intermediate position ; the ape with its arboreal agility is in need of binocular vision—a function which reaches its highest development in man.

Another point in the case here related is interesting. Her hypertelorism is right-sided. Although her right eye is the fixing eye of choice and the one which is more nearly emmetropic, yet it is the right eye which deviates more widely. The turning of her head to the left is an effort to bring objects into line with the right eye, and this explains her torticollis.

Ocular hypertelorism by derivation implies wide-apartness of the eyes (ὑπέρ, too much ; τήλε, apart ; δείξω, to separate). To describe a case as " unilateral ocular hypertelorism " is perhaps, somewhat contradictory, but the term " ocular hypertelorism " is established and has such merit that it should be retained.

Conclusion.

A case of right-sided (unilateral) ocular hypertelorism is described. External deviation of the fixing (right) eye is probably responsible for an associated torticollis. There is no mental defect.

In preparing this paper valuable help has been received from Dr. H. Graham Hodgson, who took the radiograms, from Dr. T. H. Whittington, who made the ophthalmological examination, from Dr. N. H. M. Burke, who carried out the Binet-Simon tests, and from Mr. E. G. Parfitt, who prepared the photographs. To all these our thanks are due.

References.

1. Greig, D. M., *Edin. Med. J.*, Edin., 1924, XXXI, 560.
2. Fridolin, J., *Virchow Archiv.*, Berlin, 1890, CXXII, 528.

BRITISH PÆDIATRIC ASSOCIATION.

PROCEEDINGS OF THE FIRST ANNUAL GENERAL MEETING.

The First Annual General Meeting was held at The Old England Lake Hotel, Windermere, on Friday and Saturday, May 4th and 5th, 1928.

First Session (May 4th, 10 a.m.).

Business Proceedings: The President, Dr. G. F. Still, was in the Chair, and there were present 44 members and 4 guests. Dr. Still made some opening remarks of welcome to the members and explained the objects of the Association.

President: Dr. Edmund Cautley was elected President for 1928-29, and the election of Officers and members of the Executive Committee followed.

Treasurer: Dr. H. Morley Fletcher.

Secretary: Dr. Donald Paterson.

Members for London: Dr. F. J. Poynton and Dr. R. C. Jewesbury.

Members for the Provinces: Dr. J. C. Spence and Dr. L. G. Parsons.

Member for Scotland: Dr. Leonard Findlay.

Member for Ireland: Dr. Rowland Hill.

Next Meeting: The place of next year's Meeting was discussed and it was agreed to leave this in the hands of the Executive Committee, though Buxton, Scarborough and Harrogate were favoured in that order.

Treasurer's Report. Dr. Morley Fletcher presented the Treasurer's Annual Report, which was adopted. This showed a balance of £33 9s. 3d.

Consideration of Rules. Dr. Parsons pointed out that Rule 13 allowed 15 minutes for a communication, although members had been informed that 10 minutes was the limit for communications this year. The President replied that the length of the communications must vary from year to year, depending on the number presented.

It was proposed by Dr. Robert Hutchison and seconded by Dr. Thursfield that Rule 17 should be abolished. This was carried.

It was proposed by Dr. Hutchison and seconded by Dr. Thursfield that Rule 2 be abolished. This was defeated.

Scientific Business.

1. Dr. Geoffrey Bourne: "An attack of acute osteitis in a case of Gaucher's disease." He described a boy of 13, a case of proved Gaucher's Disease, who, one year after splenectomy, suffered from two types of skeletal lesion. The first resembled acute rheumatism and affected the knee and hip joints, producing pain, tenderness and synovitis, but unamenable to salicylate. The second was indistinguishable from an acute osteo-periostitis, shewing fever, leucocytosis, redness, swelling, œdema and pain, but the condition twice resolved spontaneously.

Dr. Thursfield, under whom the child had been in Hospital, stated that the fluid taken from beneath the periosteum of the swelling contained Gaucher cells.

2. Dr. Maitland-Jones: "Pachymeningitis hæmorrhagica of infants." He described three cases of this condition, aged 16, 5 and 3 months. The characteristics of this syndrome were enlargement of the head, convulsions, retinal hæmorrhages and blood pigment in the cerebro-spinal fluid.

Dr. Schlesinger reminded the members of Dr. Trotter's case.

Dr. Cameron described two cases which he had seen and drew attention to the marked depression of the fontanelle and collapse of the head, due to absorption of fluid, which occurred in one of his cases.

3. Dr. Norman Capon: "Hæmorrhagic diathesis in the newborn." He described 16 cases and excluded those associated with sepsis, syphilis or birth injury. Three cases had died. He believed that intramuscular injection of citrated blood was the best method of its administration. Occasionally it was given in the superior longitudinal sinus. 9 c.cm. of blood were added to 1 c.cm. of 4% citrate, and on the average 27 c.cm. of this mixture were given.

Dr. Lapage and Dr. Nabarro took part in the discussion. Dr. Rogers had followed up 11 cases and thought that there was no tendency to recur. Dr. Thursfield noted that horse serum seemed to be quite as good as human blood. Dr. Naish said that hæmoplastin was excellent. Dr. Eric Pritchard suggested that sepsis was often present although not apparent.

Dr. Cameron asked whether Dr. Capon thought that the later the hæmorrhage occurred the better the prognosis. Dr. Capon replied that he had not noticed this to be a fact. He thought that in certain cases horse serum might be beneficial, but on the whole human blood was universally applicable and most useful.

4. Prof. F. Langmead: "A case of intracranial hæmorrhage in a child due to congenital miliary aneurysms." He described the case of a girl aged 7 years, who was quite well, and suddenly complained of pain in the head and showed dilated pupils and loss of reflexes. There was no fever. Blood was present in the cerebro-spinal fluid and there were small hæmorrhages in the discs. The skull was opened and the ventricles explored, showing the right to be full of clot. Post-mortem examination confirmed this and many miliary aneurysms were found on the perforating arterial vessels. He thought this to be extremely rare. The hæmorrhage had been due to the bursting of one of these aneurysms.

Dr. Morley Fletcher suggested that the aneurysms were due to congenital absence of elastic tissue of the cerebral vessels and Dr. Robert Hutchison agreed with this. Dr. Bellingham Smith described a case of cerebral hæmorrhage thought to be due to aneurysm which recovered. Dr. Wyllie pointed out that congenital miliary aneurysms were thought to be familial, which point was absent in this case. Dr. Wilkie Scott described two cases. Dr. Wilkinson thought lumbar puncture a dangerous procedure in such cases.

Dr. Langmead stated that microscopically there was no deficiency of elastic tissue in his case.

5. Dr. H. T. Ashby: "Ergot poisoning among children." He said that rye bread was eaten by some Jews and in his investigation in Manchester the rye grown was found to be ergotized. The ergotized rye was fully tested, physiologically and bio-chemically. The symptoms complained of by the children eating rye bread were chilblains, cold hands and feet and attacks like Raynaud's disease, colic, nausea and vomiting. Although it could not be proved, probably ergotized rye contributed towards abortion. The rye was grown in this country.

Dr. Still reminded the members that it was the practice of Dr. Eustace Smith to give large therapeutic doses of ergot for such complaints as enuresis without ill effect. Dr. Ashby thought that medicinal ergot was most inactive and Dr. Thatcher reminded those present that at an obstetrical meeting in Edinburgh medicinal ergot was said to be quite inactive.

6. Dr. C. P. Lapage: "Delay at the pylorus in older children." He described cases as shown by X-ray tests. From a series of sixteen cases he deduced that there were two types:

(1) the neuro-excitable pylorus, showing delay from any upset of metabolism, such as overstrain, nervous or physical, often with a history of continued dyspepsia and perhaps of vomiting in infancy (six cases); (2) those with a normal pylorus upset by some septic focus in the abdomen, such as appendix, infected glands, enteritis, etc. The pyloric reflex in appendicitis illustrates this (ten cases).

Dr. Langmead described a case of pyloric delay which was undoubtedly cured by the removal of a septic appendix. Dr. Schlesinger remarked on a follow-up of cases of pyloric stenosis which showed in 5 cases a palpable pylorus many years after infancy. Drs. Cameron and Spence took part in the discussion. Dr. Wilkie Scott thought that keeping patients on their right side after meals with this complaint a great help.

7. Dr. J. M. Smellie: "The Value of irradiated milk in the treatment of debilitated children of school age." A group of 50 children was divided into two equal parts. To one a pint and a half of irradiated milk per day was given and to the other a pint and a half of non-irradiated milk, both for a period of 8 months. The children were all weighed and measured carefully and kept under observation. No difference was found in the progress of the two groups and one could not be said to be more intelligent than the other. The milk was exposed to ultra-violet light for 30 minutes in flat dishes which were kept moving, and an electric fan blew away the ozone. It had been noticed that the bacterial count of the milk had been reduced by 50% by the irradiation.

Dr. Nabarro agreed that this was so. Drs. Jewesbury, Morley Fletcher, Rogers and Schlesinger took part in the discussion.

Dr. Parsons thought the irradiated milk was useful and satisfactory for infants, and that some of the ergosterol products on the market were excellent in the prevention of dental caries or if a child had a low fat tolerance.

8. Dr. J. S. Y. Rogers: "Duodenal ulcer in two successive infants in the same family." One of these died in infancy in Edinburgh and was proved post mortem. The second died in February of this year in Dundee. They were very typical cases. Dr. Rogers enumerated the possible causes of duodenal ulcer, but could add nothing as a help to its early diagnosis.

Second Session (May 4th, 8.30 p.m.).

9. Dr. Hector Cameron: "Imperative impulses and obsessions in childhood." He emphasized the part played by the mother in causing obsessions and stereotyped actions in childhood. In thumb-sucking, masturbation, nail-biting and air-swallowing the trouble was often perpetuated by ineffective efforts to forbid it. If mechanical apparatus were used, it was important that the child should not appreciate its purpose. A dental plate preventing approximation of the incisors was shown for use in bad cases of nail-biting or of air-swallowing. Examples of obsessions due to maternal anxieties were recorded.

10. Dr. Nabarro: "Modern methods of control of infectious diseases." He described his experience of immunization against diphtheria, measles and scarlet fever in an institution.

Drs. Smellie, Neale and Pritchard took part in the discussion.

Dr. Leonard Findlay described how between 1,000 and 1,500 days' work were lost each year by the nurses in his Hospital through infectious diseases. All the nurses were now immunized and diphtheria had practically ceased to occur. In an attempt to immunize patients against chicken pox, in only four cases was this successful, and that was by vaccinating patients from the vesicle wall obtained from a case of chicken pox. Vaccination with serum taken from an active case failed.

11. Dr. K. D. Wilkinson: "Electrocardiographic changes in the hearts of children with diphtheria." He said that routine electrocardiographic examination of children with diphtheria showed that marked electrocardiographic abnormalities fell into two groups. The first comprised

various grades of auriculo-ventricular heart block, and this, although an indication of myocardial damage, was not usually fatal even when well marked. The second comprised bundle branch block and was evidence of abnormal conduction in the ventricle itself. Here, in contradiction to the common clinical finding, the left branch of the bundle was more commonly defective. These cases were invariably fatal.

Dr. G. Bourne confirmed these observations.

12. Dr. Parsons with Dr. A. V. Neale: "The pathology of coeliac disease." From a case described by Ryle of obstruction of the lacteals an impression had gained ground that lacteal obstruction was a feature of the pathology of coeliac disease. In Dr. Parson's case the lacteals were permeable. Within limits the fat intake increased fat absorption. When cured, coeliac cases tended to develop a deposition of fat and configuration of body like that of Frohlich's syndrome.

Drs. Harris and Wilkinson took part in the discussion.

13. Dr. Schlesinger: "The incubation period of rheumatic fever." He suggested that rheumatism had an incubation period of from 8 to 12 days, and charts were shown demonstrating recurrence of symptoms from 8 to 12 days after a sore throat.

Dr. Bellingham Smith questioned the advisability of herding together cases of rheumatism, since he had frequently seen outbreaks of sore throat among such cases, resulting in fresh exacerbation of symptoms.

Drs. Thatcher, Marshall, Nabarro, Parsons, Wilkinson and Thursfield took part in the discussion.

14. Dr. A. E. Naish: "Lung consolidation in association with rheumatic carditis." He showed microphotographs of the lungs of six patients with rheumatic carditis and pulmonary consolidation. Endothelial proliferation was a marked feature in all and corresponded to that described by Coombs as distinctive of reaction to the *Streptococcus rheumaticus* in other parts. He pointed out that the temperature and respirations were scarcely disturbed even when the consolidation came on rapidly, and suggested that the patches of dullness, so commonly found in association with carditis, were of the nature of a specific rheumatic pneumonia.

Dr. Robert Hutchison described an investigation made some years ago by himself and said that the condition was a subacute pneumonic one. Professor Langmead said that it was really a rheumatic pneumonia, and he had found signs in the right lung as well as the left. Drs. Bourne, Schlesinger, Wilkie Scott took part in the discussion. Dr. Sheldon suggested that the diaphragm in such cases moved badly on the left side and thought that a collapse of the lower lobe of the lung would result and thus explain the symptoms.

Third Session (May 5th, 10 a.m.).

15. Dr. Dingwall Fordyce: "Corporal punishment in schools." He said that dull and backward children went to special day schools for feeble-minded children, where they were under the care of women. Such children might need corporal punishment and very firm handling. Rheumatic children were nervous and erratic and inclined to be wilful, and these children were often punished, although they should be the last to receive punishment.

Dr. Still reminded the members that for 600 years the discussion as to the advisability of corporal punishment had been debated. Dr. Cameron pointed out the benefit he had obtained by reading Locke's book on corporal punishment in children

16. Dr. J. C. Spence: "The so-called epituberculosis infiltration of the lung." He said the features were signs of consolidation at the apex, no symptoms of dyspnoea or illness, temperature normal, intracutaneous tuberculin test strongly positive. The child would be ill for

from six months to a year and then the whole thing would rapidly clear up. Very few post-mortem examinations were obtained of such cases. Occasionally they died of miliary tuberculosis.

Drs. Still, Pritchard, McNeil, Rogers and Naish took part in the discussion. Dr. Findlay suggested that this picture was possibly produced by superadded non-tuberculous pneumonia in a tuberculous child.

17. Dr. Donald Paterson: "Mediastinal tuberculosis." He described the case of a boy aged six, whose chest was X-rayed and shortly afterwards a feverish illness occurred. In the middle of this an X-ray of the chest showed marked shadows about the hila of the lungs. No physical signs were found in the chest or in the child, and he felt quite fit throughout the illness. When the fever settled the shadows remained about the root of the lungs. The intracutaneous tuberculin test was strongly positive. It was suggested that this was the clinical picture of an infection of the mediastinal glands.

Drs. Pritchard, Langmead, Wilkie Scott, Alexander, Vining and Findlay took part in the discussion.

18. Dr. Bellingham Smith: "Insulin in two cases of coeliac disease." He described two cases of coeliac disease, aged 3½ years who were doing extremely badly and on an average mixed diet were given 2½ units of insulin daily. In three months they had gained 8 pounds. He suggested that the improvement was due to the stimulation of carbohydrate metabolism and he wondered whether we were not concentrating too closely on the faulty fat metabolism in this disease. The stools had improved, containing only 22% of fat.

19. Dr. K. D. Wilkinson: "The results of tonsillectomy in rheumatic children in lessening the incidence of cardiac disease." He described an unselected series of rheumatic children who were followed up and re-examined, 56% having retained tonsils, 44% having tonsils removed. The severer cases had been operated upon rather more often than the slighter; nevertheless, normal hearts were found in the proportions of 74% (in the tonsillectomized) to 20% (untonsillectomized). The tonsils could be removed safely and with benefit early in rheumatism or chorea. Disturbance was uncommon, and improvement almost invariable. After-results show a marked diminution of cardiac disease in the tonsillectomized.

Drs. Bourne, Thursfield and Vining took part in the discussion.

20. Dr. Edmund Cautley: "Some causes on paroxysmal apnoea and dyspnoea." He drew attention to cases of paroxysmal apnoea occurring in the first month of life, rarely later, from no apparent cause. Respiration stopped suddenly or gradually, and the child became more or less blue. There was no initial disturbance, no sign of flatulence or colic, and no cry indicating any distress. Attacks might occur daily or even hourly, or the first one might prove fatal. In the intervals the child seemed well. Possibly there was some damage to the bulbar region of the brain at birth. In three recent cases no evidence of a causal factor could be found during life or after death. These cases must be differentiated from those of apnoea, secondary to dyspnoea from various causes or following respiration of Cheyne-Stokes type. Dr. Cautley's three cases were similar to those described previously by Dr. Still.

Dr. Naish discussed the paper.

21. Dr. Thursfield: "Myelocytic leukæmia and error in diagnosis." He described a child aged nine, with a greatly enlarged spleen, fever, one million red and 7,000 white cells, of which 500 were myelocytes. The hæmoglobin was 20%. After transfusion the myelocytes rose to 1,700. Three months later the red cells had reached three million and the myelocytes had disappeared. A fragility test was then done and the case proved to be one of acholuric family jaundice.

22. Dr. Eric Pritchard: "The treatment of hydrocephalus." He said that before undertaking treatment of these cases, it was essential to discriminate between the communicating and non-communicating cases by a method of injecting indigo-carmine or other dye into the

lateral ventricles. Communicating cases could be treated with highly successful results by a system of dehydration. The method was to reduce the intake of fluid to from 16 to 20 ounces in the twenty-four hours and encourage diureses and free action of the bowels. Thus treated, all cases of hydrocephalus, whether obstructive or otherwise, ceased to increase, and in many cases actually decreased. In quite a large number of communicating cases the cure was permanent by the gradual establishment of collateral channels for the absorption of cerebro-spinal fluid.

Drs. Parsons and Nabarro took part in the discussion.

23. Dr. R. C. Jewesbury: "The protein requirements of infants." He said that the optimum protein requirements for an infant were 1·6%. He described a clinical picture which he called "protein intolerance."

Drs. Cameron, Findlay, Parsons and Langmead disagreed with him and were not able to recognize this picture. Dr. Pritchard thought that high protein feeding caused hyperchlorhydria and dyspepsia in later childhood.